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*DEDICATUR*

*PRIMUS VIR BOGORI NECNON TJIBODAE*

*INVESTIGATORIBUS EXTRANEIS LOCUM*

*AD*

*BIOLOGIAM TROPICAM INQUIRENDAM FECIT*

*OPUSQUE TREUBIANUM IN POSTERUM PERMANEBIT*

*EXEMPLUM*

*INVESTIGATORIBUS DIRECTORIBUSQUE DIGNISSIMUM*

*We never can forget*
*Those rubber boots, those bathing suits,*
*And that collecting net.*
*Those sings and things will soon take wings*
*But thru the coming years*
*Whate'er the scene, dear formaline*
*Will fill our eyes with tears,*
*Whate'er the scene, dear formaline*
*Will fill our eyes with tears.*

WOODS HOLE MARINE BIOL. LAB. SONG

*Oh the wonderous laws which bind*
*Living things of every kind,*
*And control their distribution in the lake,*
*Temperature and* $CO_2$
*Pressure, light, and ions too,*
*All determined by the tests we've learned to make.*

UNIV. OF MICHIGAN BIOL. STA. SONG

*Oh we are the students of M.B.L., and a jolly gang are we*
*We dig, we cut, we fish around from morn till dewy eve,*
*We mutilate the flat worms, and tickle the lobster's toes*
*And wonder why old Nereis has warts upon his nose.*
*Wig, wig, wig, wig, wiggle old Nereis goes*
*Tick, tick, tick, tick, tickle the Lobster's toes,*
*Exopodite, endopodite, basipodite as well*
*What happens to these animals I'd surely hate to tell.*

CHARLTON, SPEIDEL & KINDRED (1919)

*I want to go back to Douglas Lake*
*The dear old camping ground,*
*Back to the mess hall on the hill,*
*Back to the fun in ladyville,*
*Back to the labs with all their joys*
*In which we did partake,*
*I want to go back, I've got to go back*
*To Douglas Lake.*

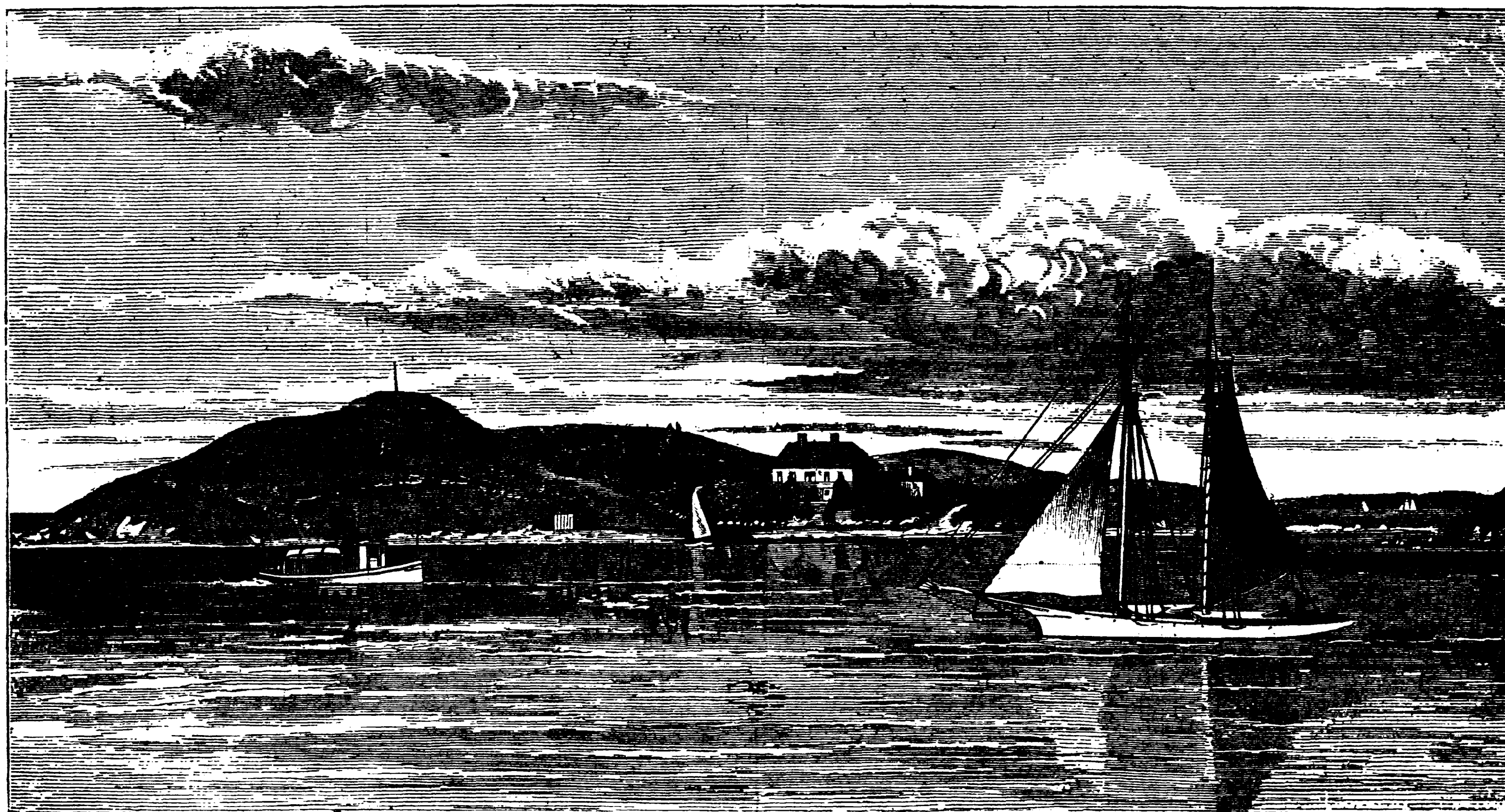
UNIV. OF MICHIGAN BIOL. STA. SONG

*There are bugs that make us happy,*
*There are bugs that make us sore,*
*There are bugs that spoil our dispositions*
*Till we never want to see them more,*
*There are bugs so very complicated*
*That their heads from tails we cannot tell*
*But the bugs that fill our hearts with sunshine,*
*Are the Big Bugs from M.B.L.*

WOODS HOLE MARINF BIOL. LAB. SONG

• Chronica Botanica, Volume 9, Number 1 •

# BIOLOGICAL FIELD STATIONS *of the* WORLD



Agassiz's School on Penikese Island (*Contemporary woodcut from Harper's Weekly*).—For reports of this early American laboratory, founded in 1873 by Agassiz, *cf.* bibliography, p. 11. For a recent interesting account see L. C. Cornish 1943, Sci. Mo. 62:315-321.

# BIOLOGICAL FIELD STATIONS of the WORLD

by


HOMER A. JACK

*Ph. D. (Cornell), B. D. (Meadville); Executive Secretary, Chicago Council Against Racial and Religious Discrimination; Sometime Lecturer, Athens College, Athens, Greece; Sometime Minister, Unitarian Church, Lawrence, Kansas.*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*"I have made use of the term 'biological station' in preference to those in more common use for the reason that my ideal rejects every artificial limitation that might check growth or force a one-sided development. I have in mind, then, not a station devoted exclusively to zoology, or exclusively to botany, or exclusively to physiology; not a station limited to the study of marine plants and animals; not a lacustral station dealing only with land and freshwater faunas and floras; not a station limited to experimental work, but a genuine biological station, embracing all these important divisions, absolutely free of every artificial restriction."* (C. O. WHITMAN, Science 7:37, 1898)

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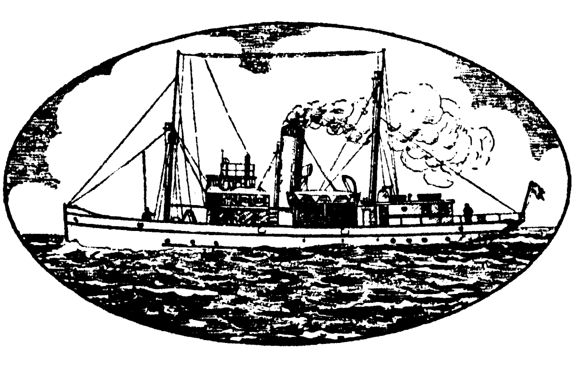

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# CONTENTS

*The purpose of this study is to synthesize and present heretofore scattered and unpublished materials describing and comparing the biological field stations of the world. If this purpose is partially fulfilled, prospective students and investigators will have a guide to aid them better in selecting a station in which to study or conduct research work. In addition, it is hoped that this study will be of some benefit to the directors of biological stations, since it may show them how their fellow-administrators are solving some of the problems attendant to the efficient organization of these institutions in many parts of the world. Finally, if a theoretical justification for studying these institutions need be given, it is merely that they have loomed large in the progress of biological instruction and research in the past and—providing they retain their adaptability—there is every reason to believe that they will remain equally important in the future.*

*Although biological stations have been in existence for more than eighty years, there is a paucity of literature about them. Biologists have been prone to leave the study of their institutions to others who rarely have the insight, if the interest, to make extensive analyses (20)*. The few materials which have been published about biological stations fall into several categories:* 1, *articles on the functions of these institutions, especially by* ANTON DOHRN *(1), Professor* C. O. WHITMAN *(2), and most recently by Professor* PEARSE *(3)* ; 2, *articles describing a particular station;* 3, *articles on several stations of a region or functional group; and* 4, *articles in the form of a directory of the stations in larger political units.*

*The first directory for any large political or geographical area was published in 1893 by* BASHFORD DEAN *(4). This consisted of a discussion of the marine laboratories of Europe. It was followed in 1898 by* RENÉ SAND'S *account (5) of the biological stations of the world. In 1899* HENRY WARD *(6) published a paper on the freshwater biological stations of the world and in 1910* CHANCEY JUDAY *(7) wrote an account of European biological stations.*

*The first extensive study of biological stations was made in 1910 by Professor* KOFOID *in his bulletin on the "Biological Stations of Europe" (8). In 1927* LENZ *(9) published his valuable directory of limnological laboratories and in the same year* MAGRINI *(10) issued his list of institutions occupied with the study of the sea. In 1928 the General Biological Supply House of Chicago began to publish its annual booklet on "Biological Field Work" (11) at North American stations. Professor* T. W. VAUGHAN *in 1937 issued his important "Catalogue of Institutions Engaged in Oceanographic Research" (12) and in that same year the author's unpublished study (13) on the biological field stations of the United States was completed.* CHRONICA BOTANICA *(14) in 1938 published a world list of scientific institutions which contained a more complete enumeration of biological stations than had ever appeared in the editions of "Minerva," "Index Generalis" or "Index Biologorum." In 1940, the author published a short description of the United States stations in "The American Biology Teacher" (15) and a series of articles on the European stations in "The Collecting Net" (16). Also in 1940 the author completed his unpublished manuscript on "The Biological Field Stations of the World" (17), of which this study is a part.*

*In addition to reviewing the existing literature, the author tried to study these institutions first-hand. Besides being a student and investigator at two stations for five summers, the author attempted to visit as many of these institutions as his time and resources permitted. Seventy-nine stations in eighteen countries in Europe, North Africa, and North America were visited by the author between 1937 and 1941. These visits and interviews (18) were supplemented by questionnaires in English and French to the directors of the stations not visited.*

*It must be emphasized that, with few exceptions, the descriptive and analytic accounts of the biological stations given in this study are corrected to 1940—before the second World War became world-wide. As the war progressed, many of these institutions greatly curtailed their activity and even suspended operation for the duration*

*** Notes and references will be found at the end of this introduction and at the end of each part of the first section of this account.**

*of the war. Indeed, a few stations were casualties of the war (19). Despite these changes wrought by the war, it has been thought useful for biologists and other scientists to have a picture of the biological stations of the world at perhaps the peak of their operation (1939-40). Thus even before the war is over or sectional armistices are declared, information on these institutions will be in the hands of those who, as students, investigators, and administrators, will be responsible for helping to make them again serve science and mankind.*

*Many biological stations normally print descriptive catalogues giving seasonal or up-to-date information on the research and instructional facilities available. Prospective students and investigators are urged to send for such a catalogue and correspond with the director before making definite arrangements to attend any station. If desired, the author through one of the* CHRONICA BOTANICA *publications will continue to act as a clearing house for information about these institutions. And if there is a demand, perhaps a second, post-war edition of at least the descriptive portion of this study can be issued.*

*The author is under deep obligation to all those who have helped to make this study possible, especially to Professors* EDWIN CONKLIN, E. A. ANDREWS, *and* JACOB REIGHARD *who, as patriarchs of biological field work in America, have given him valuable historical materials; to Professors* E. LAURENCE PALMER, ALBERT HAZEN WRIGHT, *and* LEONARD S. COTTRELL, JR., *of his graduate committee at Cornell University; to Professors* ROBERT E. COKER *and* GEORGE R. LARUE *who, as former directors of the Allegany School of Natural History and the Biological Station of the University of Michigan respectively, accepted the author as a student in their institutions before he matriculated in college; and to Dr. and Mrs.* FRANS VERDOORN, *without whose aid and encouragement this study could not have been published.*

*The author is grateful to the directors of all of the biological stations for helping him to compile the descriptive part of this study and often for giving him hospitality during his brief visits to many of these institutions. The author is especially grateful to Dr.* W. BEIJERINCK *of the Biologisch Station at Wijster, Professor* J. BRAUN-BLANQUET *of the Station Internationale de Géobotanique Méditerranéenne et Alpine, Professor* ATTILIO CERRUTI *of the Istituto Demaniale di Biologia Marina di Taranto, Dr.* C. CROSSLAND *formerly of the Marine Biological Station of the Fouad I University, Professor* ODÓN DE BUEN *formerly of the Instituto Español de Oceanografía, Dr.* ROBERT B. GORDON *of the Allegany School of Natural History, and Dr.* F. RUTTNER *of the Biologische Station Lunz.*

*Above all, the author is deeply indebted to his parents,* CECELIA *and* ALEXANDER JACK, *who sought in every possible way to give him opportunity for study and travel. To them, this study is dedicated.*

CHICAGO, ILLINOIS, U. S. A.
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National Academy of Sciences. 1937, pp. 73-225. — (13) HOMER A. JACK: Biological field stations—their history, organizations, educational contributions, and conservation relations. 196 pp., 26 figs., 37 tables. (Unpublished thesis, Cornell University Library). 1937. — (14) FRANS VERDOORN (*ed.*): World list of institutions, stations, museums, gardens, societies, and commissions. Chronica Botanica (Leiden) 4(4-5):301-83, 1938. — (15) HOMER A. JACK: Close to nature: biological field stations. The American Biology Teacher 2:141-45, 180-83. 3 figs., 1940. — (16) HOMER A. JACK: The biological field stations of Europe. The Collecting Net (Woods Hole) 15:5-6; 25, 31-33; 45, 51-52; 70-71; 96-98; 117-18; 137-38; 152-53; 184-86; 206-08, 1940. — (17) HOMER A. JACK: The biological field stations of the world—A comparative and descriptive study. 1,001 pp., 114 tables, 4 plates. (Unpublished thesis, Cornell University Library). 1940. This may be obtained from the Cornell University Library through inter-library loan. — (18) *Cf.* HOMER A. JACK: Language difficulty. Science 89:558. 1939.—(19) "During the recent air raids of Plymouth, the Laboratory of the Marine Biological Association suffered severely. The buildings, though still standing, have sustained heavy damage. All windows except a few on the south side of the top floor of the main building have gone; ceilings are down, doors wrenched off, and much structural damage caused by the blast. The director's house was completely burned out. The library, very fortunately, is intact except for the loss of windows and the skylight, and it has now been made waterproof ... The Easter class house will no doubt have to be rebuilt, but most of the roof remains. Other buildings, including the dogfish house, director's garage and stores, and the constant temperature rooms, have all sustained damage . . . The tanks on the north side of the Aquarium burst and the supply pipes broke, but it is hoped that some part of the circulation may be restored before very long . . ." (*cf.* Science 93:445). — (20) An outstanding exception is The Woods Hole Marine Biological Laboratory, *by* FRANK R. LILLIE. University of Chicago Press, 284 pp., 1944.

**The Purpose of Biological Stations:** — A biological field station may be considered as any institution which offers field instruction or research in one or more of the theoretical biological sciences and is a separate administrative unit located in the field. In the actual practice of the institutions, the pendulum has swung between research and instruction several times. And the problem has always been, as Professor C. O. WHITMAN posed it in 1893, "to combine the two [instruction and investigation] in such relations that each would contribute most to the same end — the advancement of science"[1].

*Nineteenth Century Stations.* — In the nineteenth century, three principal types of biological stations evolved. The first kind of station to develop in Europe was the seaside laboratory and aquarium. Facilities were furnished for marine research, with a public aquarium being maintained principally to subsidize the research work of the institution. The Zoological Station of Naples fell into this class. Its founder, Dr. ANTON DOHRN, rightfully called it "a battlefield where all the different zoological armies [systematists, anatomists, physiologists, and embryologists] may meet and fight their common adversaries [error and ignorance]"[2].

Quite opposite in purpose was the seaside school of natural history which was the first kind of station to appear in America. Its aim was to offer marine instruction to students and teachers. With the establishment of this type of station, of which LOUIS AGASSIZ's Anderson School of Natural History was representative, the battle royal began. Professor E. RAY LANKASTER, for example, wrote contemptuously in 1880 of AGASSIZ's venture, "the spasmodic descent upon the seacoast in a summer vacation . . . is a delightful thing . . . but it is not in this way that the zoology of today can be forwarded"[3].

Toward the end of the nineteenth century, a practical compromise was reached in this controversy with the rise of the third kind of station, the

so-called marine observatory. Here both marine research and instruction were combined to varying degrees. The Marine Biological Laboratory at Woods Hole, Massachusetts, was a representative of this type of station. Professor WHITMAN, its director, realistically described its practice when he said, "instruction . . . was accepted more as a necessity than as a feature desirable in itself. The older ideal of research alone was still held to be the highest, and by many investigators was regarded as the only legitimate function of a marine laboratory"[4].

*Twentieth Century Stations.* — It had been occasionally implied that biological stations made their maximum contribution to the progress of biology during the nineteenth century and that in the twentieth century they would decline. Not only have these institutions survived, but they have flourished, principally due to their adaptability from nineteenth century patterns to twentieth century needs. The typical biological station of the twentieth century has been organized to encourage research and instruction in one or more of the biological sciences by offering facilities for these types of work in one or more kinds of environments. This emphasis on various environmental conditions, in addition to the seaside, was envisaged by Professor WHITMAN, "I have in mind . . . not a station limited to the study of marine plants and animals; not a lacustral station dealing only with land and fresh-water faunas and floras . . . but a genuine biological station, embracing all these important divisions"[5]. In addition to exploring new types of biological environments, typical biological field stations have often sponsored actual research projects. Also there has been a new appreciation of the importance of instruction. As Professor WHITMAN prophetically stated, "with increase and specialization in science the investigator himself becomes more and more dependent upon the instruction which he draws not only from books and journals, but also directly from his colleagues and his pupils. . . We could not wisely exclude instruction [from biological stations] even if made free to do so by an ample endowment"[6].

Despite the rise in the twentieth century of the typical biological station which offers both research and instruction, a number of contemporary institutions have confined themselves either to research or instruction. The biological research station confines itself solely to providing opportunities for research in addition to carrying on research projects of its own. Thus Dr. REINHARD DOHRN re-emphasized the original purpose of the twentieth century Zoological Station of Naples, "It was founded to enable naturalists to carry on their studies with the utmost economy of time, energy, and money. This is still, in my opinion, its fundamental *raison d'être*"[7]. Opposed to the biological research station is the biological nature camp, an institution largely American in origin. Its purpose is to train students in elementary field biology (*i.e.*, nature study).

Quantitatively, it is estimated that about one-half of the contemporary biological stations in the world are biological research stations, offering no facilities for instruction. About two-fifths of the world's stations offer both facilities for instruction and research, while about one-tenth of these institutions offer instructional facilities only. For the stations in the United States, the proportion differs: slightly less than one-half are typical biologi-

cal field stations offering both instruction and research; one-fourth are biological research stations; and almost one-third are biological nature camps.

Perhaps a case could be made for the relationship between the longtime political and educational philosophies of a country and the purposes of the biological stations within its borders. It is worth noting that some of the democracies with a tradition for popular education emphasize formal instruction at the biological stations within their borders (*e.g.*, three-quarters of the United States stations and more than two-thirds of the British stations), while some political areas without a long democratic tradition emphasize research (*e.g.*, more than one-half of the German stations, more than four-fifths of the Russian stations, and all of the Italian stations).

*References:*—(1) Pop. Sci. Mon. 42:459-71, 1893. — (2) Rept. Brit. Assoc. Advan. Sci. 1873:408-12, 1874. — (3) Nature 21:497-99, 1880. — (4) Science 7:37-44, 1898. — (5) *Ibid.* — (6) *Ibid.* This was reaffirmed forty years later by the trustees of the Marine Biological Laboratory. *Cf.* Frank R. Lillie: The Woods Hole Marine Biological Laboratory. University of Chicago Press, p. 92, 1944. — (7) Nature 113:449-50, 1924.

**The History of Biological Stations:** — From the incomplete historical material available, it appears that the first biological station — as the term has been previously defined—was established in 1859 at Concarneau, France. Earlier in the nineteenth century, biologists came to recognize the value of staying in one place long enough to be able to study living materials in their natural environment. As Professor R. Legendre said, "Bientôt, la simple récolte et la seule dissection ne suffirent plus"[1]. In the eighteen thirties some Swedish naturalists established what Professor Charles A. Kofoid called "an impromptu summer biological station"[2]. In 1843 at Ostend, Belgium, Professor P.-J. Van Beneden founded what René Sand[3] considered the first biological station in the world. Legendre likewise said that this was "le premier centre d'études maritimes,"[4] although Kofoid[5] considered it as merely a kind of formalized seaside excursion and not the first biological station in the world. In that same decade Professor Carl Vogt made several unsuccessful attempts to establish a biological station and in 1848 Professor Valenciennes, an associate for a time to Baron Cuvier, began to explore the coast of Brittany for biological specimens. His efforts resulted in the establishment, in 1859, by Professor J. J. Coste of what exists today as the Laboratory of Marine Zoology and Physiology of the College of France at Concarneau. Fourteen years later, the first station was founded in North America: Louis Agassiz's Anderson School of Natural History on Penikese Island[6]. About the same time Dr. Anton Dohrn founded the Zoological Station of Naples.

*Their Increase.* — The biological station idea spread swiftly and in many directions from its original centers in northwestern France (Concarneau) and in northeastern United States (Penikese Island). In the decade ending in 1880, sixteen biological stations were established, scattered between Sweden and the Black Sea in Europe and Illinois and Virginia in the New World. And by 1888 both the Marine Biological Laboratory at Woods Hole, Massachusetts, and the Laboratory of the Marine Biological Association at Plymouth, England, were in operation. The greatest number of

field stations were founded in the decade ending in 1930, when seventy new ones were established. Although these institutions have almost continuously been abandoned, there has been a net increase in the number of new stations established each decade, with a notable lessening of this increase in the decade including the first World War and the decade after the depression of 1929.

*Their Founders.* — Biological field stations have been established by many different types of individuals and institutions. Although most biological stations exist, at least in part, to aid scientific research work, scientists themselves have not always had the financial resources to establish these institutions. There have been a few scientists (*e.g.*, ANTON DOHRN or ALBERT I, Prince of Monaco) who have been able to use their private fortunes to build up biological stations. Less wealthy scientists have had to use their personalities to persuade others to give. Both royalty (*e.g.*, King FERDINAND I of Bulgaria) and business men (*e.g.*, JOHN ANDERSON) have been patrons for the establishment of these institutions.

Most biological stations, however, have been established by the help of an institution or special committee, with some one scientist taking the administrative initiative. A list of the types of institutions which have aided in the establishment of biological stations include governmental departments (*e.g.*, Danish Ministry of Agriculture), national scientific institutions (*e.g.*, Carnegie Institution of Washington), national scientific societies (*e.g.*, Netherlands Zoological Society), universities (*e.g.*, University of Kiel), local institutions and societies (*e.g.*, Berlin Museum), and colleges (*e.g.*, South Dakota State College). Occasionally special committees have been founded for the express purpose of starting a biological station. These have been international (*e.g.*, Jungfraujoch Scientific Station), national (*e.g.*, Freshwater Biological Association of the British Empire), and local (*e.g.*, Liverpool Biological Committee).

More than one-half of the stations in the United States have been established by universities or colleges. There is apparently a world-wide trend away from the foundation of these institutions by private individuals. This might be explained by the fact that the organization of a field station involves greater expenses than formerly, when an individual scientist with a few students, much enthusiasm, and little equipment could establish a station or induce a rich patron to finance one.

*Their Development.* — Once a station is founded, it is naturally often not equipped to cope with all the problems which it often must face. Several stations have experienced considerable delay between the time they were started and the time their instruction or research program was begun. And being very dependent upon the immediate natural environment, some stations have had to move from their original sites, because of the unfortunate choice of the original site or because of the encroachment of civilization.

*Their Abandonment.* — Biological stations have been abandoned for a number of reasons. The most common causes for discontinuance have been the death of the founder or director (*e.g.*, LOUIS AGASSIZ's death soon brought an end to the Anderson School of Natural History), fire (*e.g.*, Cornell University Biological Station), marine disaster (*e.g.*, the wreckage

of the *Pourquoi Pas?*), war (*e.g.*, Royal Hungarian Marine Biological Station), curtailment of funds (*e.g.*, The Biological Station of the United States Bureau of Fisheries at Woods Hole), and personal disagreements (*e.g.*, Mountain Laboratory of the University of Utah).

Since the first biological station was founded, at least ninety of these institutions — approximately one out of four established — have gone out of existence. The life span of abandoned stations has varied widely. One institution (*i.e.*, The Biological Station of the United States Bureau of Fisheries at Woods Hole) closed after being in operation fifty-one years. Others (*e.g.*, Lake Cooper Biological Laboratory) have closed their doors after one season. The average length of life of the abandoned stations has been about sixteen years. The average length of life of those stations existing in 1940 was about twenty-six years, with the oldest founded in 1859 and the youngest founded in 1940.

*References:*— (1) Revue Scientifique 70:750-53, 1932. — (2) U. S. Bur. Educ. Bull. 1910(4):1-360, 1910. — (3) Rev. Univ. Bruxelles 3:23-47, 121-51, 203-35, 1898. — (4) Revue Scientifique, *op. cit.* — (5) U. S. Bur. Educ. Bull., *op. cit.* — (6) *cf.* Harper's Weekly 17:701-02. Popular Science Monthly 40:721-29. Nation 17:174-75. *Ibid.* 31:29. American Naturalist 32:189-96. Nature 6:34. *Ibid.* 8:454-55. *Ibid.* 11:167-68. *Ibid.* 21:497-99. *Ibid.* 31:174-75. Science 58:273-75. Literary Digest 79:68-69. New York Daily Tribune, March 12, 1873. *Ibid.* March 27, 1873. *Ibid.* July 9, 1873. *Ibid.* July 10, 1873. New York Times, March 27, 1873. *Ibid.* April 23, 1873. *Ibid.* May 22, 1873. FRANK R. LILLIE: The Woods Hole Marine Biological Laboratory. University of Chicago Press, pp. 15-23, 1944. Sci. Mon. 62:315-21.

**The Location of Biological Stations:** — The uniqueness of biological field stations lies in their location, in the opportunities they offer students and investigators to study biological forms at close range in their natural environment. While political, geographical, and other considerations enter into the establishment of biological stations, these institutions are usually located on sites near or within a unique biological environment, or else in an area where an abundance and variety of biological forms are easily accessible. Some believe the ideal to be an itinerant station or a "floating station," which provides more freedom to move to new sites frequently or periodically. Similar results in extending the working radius of a station have been obtained by establishing annexes or by removing a whole station to a new site after a period of years.

*Ecological Location.* — About one-half of the stations of the world are marine biological stations. The remaining ones are about evenly divided between being primarily situated for work in fresh-water biology and in terrestrial biology. While biological stations have penetrated the arctic (*e.g.*, Greenland), the desert (*e.g.*, Morocco), and the jungle (*e.g.*, Panama), there are many biological areas in the world possessing none of these institutions. Professor T. W. VAUGHAN has pointed out the "paucity of oceanographic stations south of the equator"[1]. Some of the larger areas without biological stations include Lake Victoria, the Caspian Sea, the Himalaya Mountains, the Andes Mountains, the tropical forests of Africa and South America, the prairies of Patagonia, the steppes of Tibet, and the deserts of Mongolia.

*Political Location.* — The estimated 265 biological stations in operation in 1940 were distributed in fifty-eight political divisions. The United States led in the number of existing field stations with sixty-three. Other

countries with a relatively large number of biological stations include the U. S. S. R. with twenty-three, France with twenty, Germany with fourteen, Japan with twelve, and Italy with ten. There are also a number of countries which, in 1940, had no biological stations within their borders. These include Turkey, Greece, Ethiopia, Iceland, and New Guinea.

There is little or no correlation between the population or size of a country and the number of biological stations it supports. Switzerland, for example, has one field station for about every 2,600 square miles of its territory, while Brazil has but one station for every 1,000,000 square miles of its land. For the political areas which have field stations, the mean figure is one station for about every 28,000 square miles. The number of inhabitants theoretically supporting a biological station also varies greatly. Every 400,000 persons in the Mountain States of the United States support a biological station in that territory. In China, on the other hand, there is only one station for every 140,000,000 inhabitants. The mean figure (for those areas having these institutions) is one station for about every 3,000,000 persons.

The greater the number of biological stations a country supports, the greater theoretical support that nation gives to biology. Such might be true if biological stations were of the same size and had approximately the same scientific output. When, however, the actual factor of size or output is considered, a country like Hungary with only one biological station is perhaps supporting more field biological research and instruction than Czechoslovakia with six of these institutions. Traditionally, some countries have followed a conscious or unconscious policy of dissipating their resources by establishing a number of small stations rather than fewer big ones. Professor HENRI LACAZE-DUTHIERS warned in the last century, "we have been able to count as many as seventeen or eighteen stations on our coasts [France] in the course of 1891. . . Is this not also an exaggeration and a dissipation of precious energies which, if concentrated into a single strong organization, might render very great service?"[2].

*References:* — (1) International Aspects of Oceanography. Washington: National Academy of Sciences. 1937. — (2) Arch. Zool. 2(9):255-363, 1891.

**The Administration of Biological Stations:** — Biological stations are sponsored by several types of organizations and institutions. They are organized usually as separate administrative units of the institution or organization which sponsor them. A director is generally appointed by the sponsoring committee to manage the work of the station. While the director's duties are concerned primarily with all the problems attendant to translating into action the educational and scientific philosophy of the institution, the two administrative problems with which most station directors are especially occupied are balancing the station's budget and giving the station the kind of publicity which will make the desired number of students and investigators attend the institution each session.

*Sponsorship.* — Biological stations usually have not sufficient financial strength to be autonomous institutions. Although separate administrative units, they are sponsored by various types of organizations and individuals. Universities and colleges appear to be the most frequent sponsors of con-

temporary biological stations. More than one-half of the stations in the United States are so supported. Scientific institutions and organizations less frequently play the role of sponsors of biological stations (*e.g.*, The Royal Society of Göteborg supports the Oceanographic Institute of Göteborg, Sweden). Governmental departments are also the sponsors of biological stations (*e.g.*, the Egyptian Ministry of Commerce and Industry supports the Fouad I Institute of Hydrobiology and Fisheries at Alexandria). In some cases, several types of organizations combine to support a biological station (*e.g.*, The Laboratory of Zoology of the University of Iaşi and the Ministry of National Education together sponsor the Marine Zoological Station "King Ferdinand I" at Agigea, Roumania). A few of these institutions are sponsored by private individuals (*e.g.*, Dr. Friedrich Morton is the sole supporter of the Botanical Station at Hallstatt, Austria). Lastly, about one-tenth of the biological stations are autonomous, being sponsored by an organization formed specially for that purpose (*e.g.*, The Bermuda Biological Station for Research is an institution founded and incorporated for the sole purpose of supporting its own scientific work)[1].

*Organization.* — Most biological stations are organized as more or less autonomous departments of the organizations or institutions which sponsor them. The parent institution usually appoints a kind of executive committee which in turn appoints a director in whom is vested most of the administrative duties. Those stations which are truly autonomous institutions often present the greatest administrative problems because they have no sponsoring institutions after which to pattern their organization and with which to integrate their functions. They often find it best to have a formal board of trustees. The executive committees or boards of trustees of the larger stations issue annual reports of the work of the institution. While most often they are summaries of research (*e.g.*, Report of the Reelfoot Lake Biological Station), occasionally they are administrative summaries (*e.g.*, Report of the Marine Biological Laboratory, Woods Hole, Mass.).

*Directors.* — The bulk of the administrative work of most biological stations falls upon the directors of these institutions. They are usually appointed to these positions by the executive committee or the board of trustees. Not infrequently in the case of younger stations, the directors have assumed their positions by being the founders of the institution (*e.g.*, Anton Dohrn, founder and first director of the Zoological Station of Naples). About one-quarter of the directorships are full-time positions. Most of the stations, however, are in operation only a portion of the calendar year and consequently these positions are part-time ones. During the greater part of the academic year, the directors are usually university or college professors, although their vocations vary from that of a superintendent of schools to a drug store proprietor. In any case, the directors are scientists, most often, zoologists.

*Finances.* — The financial problems facing the directors of biological stations are those facing most other institutions: how to obtain an adequate income and how to spend it wisely. Biological stations obtain the largest share of their income from the services they render in providing facilities for research and instruction to investigators and students. Even so, most

of these institutions are unable to meet their expenses through tuition and laboratory fees and must turn to supplementary sources of income. These include income from their sponsoring organizations (in the form of direct subsidies), from the government (for scientific services), and from the public (for admission to aquariums). Autonomous institutions must seek even a wider source of income which often include outright government grants, endowments, the sale of biological specimens, and membership and patron fees. Once acquired, the income of biological stations is expended on administration, instruction, research, and the maintenance and operation of laboratory and living facilities.

The actual budgets of biological stations vary with their purpose, size, and age. The Marine Biological Laboratory has had the largest budget: $185,096 in 1938. Several of these institutions, on the other hand, have annual budgets of less than one thousand American dollars (*e.g.*, Biological Laboratory of Lake Orédon, France, has an annual budget of 4,000 francs or $106). Any attempt at obtaining an average budget is meaningless because of the varying currencies, standards of living, and even accounting practices. It is worth noting, perhaps, that England has an average yearly budget of $28,470 per station, whereas Italy has an average annual budget of $421 per station (excluding the international Zoological Station of Naples). The average annual budget of one-half of the existing United States stations is $21,130.

*Publicity.* — Since the financial success of most biological stations is very much dependent upon the attendance of a full quota of students and/or investigators, various publicity practices have been devised to attract these students and investigators. In the United States, it has been the custom for most of these institutions to issue annual announcements of their available facilities. About three-quarters of the United States stations publish such announcements. They may vary from a one-page mimeographed sheet (*e.g.*, the 1940 announcement of the San Francisco State College Science Field Session) to a 35-page booklet (*i.e.*, 1940 announcement of the Marine Biological Laboratory). The stations in the United States which do not issue annual announcements are either in the early stages of existence or offer only research facilities, in which case a detailed printed announcement may serve for several years. Several of the American stations supplement the publicity given in their annual announcements by inserting news notices in the unpaid columns of certain scientific journals (*e.g.*, *Science*) or paid advertisements in others (*e.g.*, *Nature Magazine*). In Europe, station announcements more often take the form of one-page brochures, printed annually and describing the current offerings in instruction or research. These are often supplemented by printed rules and regulations which are issued irregularly.

Directors of biological stations often obtain general publicity for their institutions by cooperating in the production of general articles about the work of the station in popular publications (*e.g.*, Machete Trails by Dallas L. Sharp in *The Atlantic Monthly* in 1930). They also coöperate in the compilation of directories of the biological stations of a political or geographical area (*e.g.*, the 1937 issue of *The Biologist* [Phi Sigma Society] devoted to Biological Summer Schools). The most effective kind of publicity for

the biological stations of all countries results from the unqualified satisfaction and enthusiasm of students and investigators who have attended these institutions. Some stations have attempted to sustain this enthusiasm by organizing loosely-formed alumni associations with irregular meetings and newsletters.

*Note:* — (1) LILLIE shows the advantage of autonomous organization in "freedom from all restrictions of local institutional control." *Cf.* FRANK R. LILLIE: The Woods Hole Marine Biological Laboratory. University of Chicago Press, p. iii, 1944.

**The Equipment of Biological Stations:** — The kind of equipment with which a biological station is able to carry out its program depends upon its purposes and its resources, to a lesser extent upon its ecological and political location. Most biological stations have some sort of campus on which are constructed one or more buildings. These are equipped with laboratories and scientific apparatus for instruction and research. In addition, these institutions are also equipped to furnish board and lodging for those in attendance. There are a few itinerant stations which often have the same problems and needs of the stationary institutions and therefore have much of the same equipment, except a permanent campus and buildings.

*Buildings.* — In planning the laboratory buildings for the Anderson School of Natural History, LOUIS AGASSIZ stated, "I was determined that we should not be satisfied with that mode of proceeding of which we have so many examples in these medieval castles for the abode of modern science. I wanted, if possible, that our rooms should correspond at once with our work"[1]. While most directors have perhaps had this philosophy of planning, they usually have not had the financial opportunity to put such architectural theories into practice in establishing or even subsequently enlarging these institutions. Several stations have started and often continued in buildings erected for other purposes: the Murman Biological Station in a monastery, the Oregon Institute of Marine Biology in an abandoned Civilian Conservation Corps camp, the Zoological Station at Villefranche in an abandoned coaling station, the Hydrobiological Section of the Scientific Institute of Peterhof in an appropriated country estate, and the Laboratory of the Fresh-water Biological Association at Ambleside, England, in veritably a medieval-looking castle.

The size of biological stations is not usually proportionate to the number of buildings, but rather to what they contain. Thus the Zoological Station of Naples is housed in one building whereas the smaller Allegany School of Natural History maintained forty-seven building units. In general, biological stations can be classified into small, medium, and large plants. The smallest number of stations have relatively large plants. The ten top-ranking institutions in regard to the size of their physical plants probably would include, though not necessarily in the order given, those stations at Woods Hole (Marine Biological Laboratory), Naples, Plymouth, Helgoland, Woods Hole (Woods Hole Oceanographic Institution), La Jolla, Friday Harbor (and Seattle), Monaco, Roscoff, and Cold Spring Harbor. All except the last-named institution happen to be chiefly equipped for marine research. The largest inland biological stations would probably include those at Douglas Lake, Michigan; Put-in-Bay, Ohio; Lunz, Austria; and Jungfraujoch, Switzerland.

*Laboratories and Apparatus.* — Whatever their size, biological stations contain various types of laboratories and rooms equipped with apparatus with which to carry on their different functions. Increasingly this apparatus has become more complicated than the original equipment of the early field stations. Today even small stations are supplied with fairly intricate apparatus which never enters the field in the sense that it never leaves the laboratory.

The laboratories and apparatus of biological stations serve primarily for general research and instruction. In addition, a number of these institutions are also equipped for research in special fields, for photography, for collecting, for repairing, and for distributing supplies. The other functions for which many biological stations are equipped include public education, miscellaneous services, and library work.

*Apparatus for General Biological Research.* — Most field stations, even if they have no laboratories equipped for special functions, do have at least one room equipped for general biological research. Such equipment includes laboratory furniture, common chemicals and glassware, running freshwater (and often sea-water), small aquariums or terrariums, electricity, and occasionally gas, compressed air, and vacuum pipes.

Those stations which have piped sea-water usually take precautions to insure the purity of the water, both at its source and during its conduct through pipes to the desk of the student or investigator. As Professor KOFOID observed, "much may be done by sedimentation and by preliminary storage in the dark to improve polluted waters for circulation in aquaria and laboratories; but, after all is said, purity of water supply is the greatest asset of the marine station"[2]. At least one station (*i.e.*, Bergen Museums Biological Station) has had to change its site because of the contamination of the waters adjacent to its original location. Another institution (*i.e.*, Oceanographic Institute of Göteborg, Sweden), desiring a certain type of sea-water, obtains it by freighter from the Bay of Biscay.

*Apparatus for Instruction.* — The nature of the instruction offered at biological stations is usually such to necessitate only the minimum of instructional apparatus. For those courses demanding inside laboratory work, class rooms and laboratories have to be provided. These often contain the apparatus furnished to the general research laboratories. In addition, they are often equipped with blackboards, charts, and microscopes. A few stations have special lecture rooms, although at most of these institutions, the lectures — if any — are of an informal nature, being often given in the laboratory or during a field trip.

*Apparatus for Special Services.* — Laboratory apparatus is often supplied for research in various special fields of science. While these fields vacillate with the trends in biology, the more common ones are bio-chemistry, physiology, and taxonomy. Other subjects for which one or more biological stations are especially equipped include bio-physics, economic fisheries, hydrography, bacteriology, and microscopy.

Photography is an important aid to field instruction and research. Most biological stations are equipped with rooms to develop and print photographic negatives. While most stations usually have only one darkroom,

the larger institutions often have several which are well-equipped with developing and printing apparatus.

Since the collection of scientific specimens has increasingly become an art, complicated equipment and even highly-trained personnel are needed. Many stations maintain boats and automobiles for collecting purposes. The boats vary greatly in number and size. Some stations use and need only rowboats and canoes. Others have large vessels, such as the 112-foot *Makrele* of the Biological Station of Helgoland. A few boats have been specially-built for scientific work, such as *The Atlantis*[3] of the Woods Hole Oceanographic Institution[4]. Stations which do have boats must have places to keep them and often employees to run them. In addition to operating boats, the stations which do a large amount of collecting must have employees who, if not formally-trained scientists, must know enough practical biology to be able to go out in the station's vessel and find the various biological forms that are wanted. One of the most famous of such collectors was Salvatore Lo Bianco who for many years was conservator of the Zoological Station of Naples.

As scientific apparatus is used at biological stations — as elsewhere — it needs adjustment, becomes broken, or wears out. At institutions situated in isolated places or at the larger ones, it is often expedient for the station itself to attempt to adjust, repair, or make research apparatus. To meet these needs, several stations have well-equipped shops for machine-work, carpentry, and glass-blowing.

Most stations have had to be equipped for the distribution of scientific apparatus and supplies to those in attendance. Equipment for this purpose at the larger institutions includes stock rooms, station stores, and, in several instances, whole departments for the sale of live and preserved biological forms.

*Apparatus for Public Education.* — The public education attempted by biological stations is usually by means of aquariums, museums, and botanical gardens. The more ambitious of each of these projects demands elaborate equipment and personnel. The aquariums vary in size from small, one-room exhibits in table tanks to very large installations as at the stations at Naples, Helgoland, and Monaco. Public museums also are often operated in conjunction with the marine aquariums (*e.g.*, Monaco). Botanical gardens are maintained by several stations. While they do not entail much equipment, they usually require the services of several gardeners and laborers to give them the constant care required for their successful operation.

*Apparatus for Miscellaneous Services.* — One of the auxiliary functions of field stations is the securing of regular hydrographic and meteorological observations, often in coöperation with other agencies (*e.g.*, the Weather Bureau and the Coast Guard in the United States). The equipment necessary to take these observations varies from simple thermometers and rain gauges to tidal stations and apparatus for measuring direct and diffuse solar radiation (*e.g.*, Oceanographic Laboratories of the University of Washington).

Other functions for which many biological stations must be equipped are administration and transportation. While much of the administrative work in connection with the conduct of biological stations is often carried


A VIEW OF THE LABORATORIES AT WOODS HOLE, CAPE

on at the offices of the sponsoring institutions, many need some kind of office and secretarial aid in the field. Likewise, while individuals often provide their own transportation to biological stations, these institutions must often provide transportation for classes and supplies. This is done by means of various types of boats and automobiles. While most stations in the United States have one or more automobiles, only a few institutions in Europe or elsewhere have such vehicles.

*Library Facilities.* — Most biological stations have some kind of library. The type varies with the purposes of the institution and the actual use to which the library is put. Some of the smaller institutions have a very small, yet adequate, collection of taxonomic manuals and reprints. Other stations have rather complete libraries on special subjects (*e.g.*, the bryological library of the Summer School of Bryology). A few stations have large libraries with bound volumes, reference books, reprints, and current serial publications on a number of biological subjects. Such collections require much equipment and the services of full-time librarians. The largest library operated by any biological station is that of the Marine Biological Laboratory. It ranks as one of the best libraries of scientific serial publications in the world.[5]

*Itinerant Stations.* — While not possessing fixed campuses or buildings, itinerant institutions nevertheless require the other necessary equipment for biological stations. Certain peculiar equipment of itinerant institutions include boats for the aquatic ones (*e.g.*, the ill-fated *Pourquoi Pas?*) and trucks, automobile caravans, and buses for the terrestrial ones (*e.g.*, Animal Ecology Field Trip of the University of Illinois). Cumbersome libraries and heavy apparatus are usually not maintained by these stations, although otherwise they possess the regular equipment necessary to care for the laboratory and living needs of their students, investigators, and faculty members.

; (ca. 1925), *after an etching by R. L. Dickinson.*

*References and Notes:*— (1) New York Daily Tribune, July 9, 1873. — (2) U. S. Bur. Educ. Bull. 1910 (4) :1-360, 1910. — (3) *cf.* annual announcement of this institution for a detailed description of this vessel. — (4) Other vessels over 100 feet in length attached to biological stations include *De Lanessan* (Cauda, French Indo-China), *Mabahiss* (Alexandria, Egypt), *Africana* (Sea Point, Union of South Africa), *E. W. Scripps* (La Jolla, California). — (5) It contains 6,000 bound volumes, 52,000 bound serial publications, 1,300 current serial publications, and 130,000 reprints. *Cf.* FRANK R. LILLIE: The Woods Hole Marine Biological Laboratory. University of Chicago Press, pp. 100-05, 1944.

**The Living Facilities at Biological Stations:** — A majority of biological stations offer living facilities to their students, investigators, and staff members in addition to opportunities for research and instruction. Some of the early field stations did not concern themselves with the board and lodging needs of those in attendance, often because these were available in nearby towns. The Zoological Station of Naples, for example, has never made an attempt to provide living facilities, other than a noonday meal. As these institutions, however, began to be established in environments removed from centers of population, their managements were forced to provide living accommodations. From the inclusion of these facilities at some stations because of sheer necessity arose their inclusion at others because of saving both time and money of the students attending them. Also the value of maintaining living facilities was recognized as making for a closely-integrated scientific community[1]. For a physiologist to live in the same dormitory as a taxonomist was liberalizing. Equally broadening was the student's being able to eat at the same table with the faculty member.

From providing board and lodging, some stations soon extended their offerings to medical service and organized recreation. Today, therefore, a great many biological stations are prepared to offer those in attendance much more than a laboratory desk and a rowboat. That these facilities exist and often entail great administrative problems and expenses do not detract from the purpose of biological stations. Indeed, living facilities are furnished so that a student or investigator may better be able to fulfill the

purpose of the institution, may better be able to use that laboratory desk and rowboat.

*Board.* — Somewhat less than one-half of the field stations of the world offer boarding accommodations to those in attendance. This proportion often varies with the political area in which the station is located. Countries which have a high proportion of their stations offering dining accommodations include Japan, Canada, and the United States. Those countries which have a low proportion of their field stations offering boarding accommodations include Italy, Germany, France, and Sweden.

The equipment which these institutions require to prepare and serve meals varies both with the resources and needs of the stations and occasionally with the customs of the country in which they are located. The larger stations in the United States have separate dining buildings with mechanically-equipped kitchens. The itinerant field stations, on the other hand, have portable cooking apparatus. One of these stations (*i.e.*, West Virginia University Biological Expedition) has a kitchen on wheels.

The administration of the boarding facilities at these institutions is usually vested with the director of the station. In a few instances it is leased to a concessionnaire or, in small European stations, relegated to the *concierge* who is paid directly by the student or investigator. At several American stations board is offered on a coöperative basis: the students, investigators, and faculty members who receive board determine the policies of the commissary department.

Several biological stations offer equipment for students and investigators to prepare their own meals. In some instances, the students are expected to coöperate in preparing the meals. At other stations the students or investigators are expected to buy their own food and prepare it separately. The Marine Biological Station of Fouad I University in Egypt is unique in that the investigator shares in the services of a cook and houseboy (*farrash*), although he is expected to buy the unprepared food at a nearby canteen.

The biological stations which do not provide board or facilities for individuals to prepare their own are usually located within walking distance of places where meals can be obtained. Indeed, several American stations have established their headquarters in hotels where students are expected to obtain board.

*Lodging.* — About two-thirds of the biological stations of the world offer lodging accommodations. Almost all of the institutions which offer boarding facilities also offer lodging. In addition, one-fifth of the stations of the world which are not equipped to serve meals are equipped with sleeping arrangements. The countries which rank high in the proportion of field stations within their borders offering lodging facilities include Roumania, the Netherlands, Japan, Canada, United States, Sweden, and France. Those countries with a low proportion of their stations providing room include Algeria, Denmark, Italy, and Switzerland.

The equipment which these institutions require to lodge those in attendance varies both with the individual station and with the standard of living for the country in which it is located. In the United States, lodging accommodations range from the large dormitories of the Marine Biological Labo-

ratory with running hot and cold water in many rooms to the few supplies needed for the students to spend the nights in a sleeping bag at the Pacific Union College Field Nature School. Many of the stations in the United States maintain attractive cabins or sometimes tents for two or three persons each. In Europe, the lodging accommodations at most field stations are in the same buildings as the laboratory work, although at several stations (*e.g.,* Zoological Station of the Netherlands Zoological Society) special structures for lodging have been erected.

The maximum number of persons who can obtain lodging accommodations at a station ranges from 275 at the Marine Biological Laboratory to less than five (*e.g.,* Biological Station of Wijster). The biological stations which are prepared to care for the lodging needs of a large number of students and investigators include, in addition to the Marine Biological Laboratory, the Biological Station of the University of Michigan (with accommodations for 200 persons) and the Lake Itasca Forestry and Biological Station (with accommodations for 100).

The biological stations which do not provide lodging are usually located near places where it may be obtained. The Lake Geneva School of Natural Science, for example, is located on the grounds of College Camp, an enterprise which furnishes lodging and board. The Oceanographic Museum and Aquarium at Monaco, although offering no lodging facilities, is located near a number of *pensions* and hotels where the investigator may obtain rooms within a wide price range.

*Cost of Living Accommodations.* — The biological stations which offer both board and lodging usually charge one sum for both of these services. This amount varies for stations within a given country and for those in different countries. The highest cost is $28.00 a week for room and board (*i.e.,* Barro Colorado Island Biological Laboratory) and the lowest cost is the equivalent of $1.34 a week at the Marine Biological Station of the Tôhôku Imperial University in Japan. The average cost per week for board and lodging at fifty-eight stations is $9.00.

Those field stations which charge relatively high prices for board and lodging usually are, 1, in remote areas where food acceptable to foreigners is relatively costly (*e.g.,* $28.00 a week at the Barro Colorado Island Biological Laboratory in Panama) ; 2, in countries where the cost of living is normally high (*e.g.,* $15.21 a week at the Bermuda Biological Station for Research, Inc.) ; or 3, in countries with an unfavorable rate of exchange with the American dollar or British pound (*e.g.,* $16.85 a week at the Biological Station of Helgoland). In the United States, the reasons for the high costs of board and lodging at some stations are either their location in relatively remote areas (*e.g.,* $14.00 a week at the Science Summer Camp of the University of Wyoming) or their location in parts of the country where living costs are usually high (*e.g.,* $10.50 a week at the Biological Laboratory of the Long Island Biological Association).

*Health and Recreation.* — Community hygiene is only considered a factor of importance at those biological stations which have a large number of students and investigators in attendance. Most of the institutions outside the United States have shown no special regard for the health of their students or investigators, except in the case of tropical countries where this

is more essential. The greatest care for the health of students and investigators at any of these institutions has been taken at the Biological Station of the University of Michigan. Here a physician is in residence to provide medical service if the need should arise. He also supervises general camp sanitation. A one-room hospital is also available at this station for any person who may need temporary medical detention.

Many of the biological stations in the United States and a few of those in other parts of the world provide organized recreational facilities for persons in attendance. In most cases the recreation is in charge of the director, often assisted by staff members and students. Excursions, picnics, campfires, and dances are some of the recreational activities offered. One of the results of the organized recreational activities at biological stations has been the growth of a series of songs, either about life at the station or about the biological forms studied.

Another result of the announced recreational activities at biological stations (together with their location) is that some students, especially in the United States, attend these institutions as much for a vacation as for the instruction they will obtain. While the recreational activities at some stations do attract vacationists, those institutions which are sensitive to the recreational needs of students and investigators do not have the frequent problem of a general exodus of students from the station to a nearby town each week-end in search of amusement.

*Note:* — (1) An appreciation of the contribution of community life to the scientific program of the Marine Biological Laboratory is given by E. G. Conklin and Frank R. Lillie in the latter's The Woods Hole Marine Biological Laboratory. University of Chicago Press, pp. 170-76, 1944.

**Instruction at Biological Stations:** — One of the primary purposes for the operation of biological stations is the field instruction they offer. More than one-half of the contemporary field stations offer some kind of formal instruction in the biological sciences and related subjects to beginning and advanced students. A number of these institutions also conceive within the scope of their activity various kinds of public education, such as the maintenance of public aquariums and museums.

Those field stations which offer formal instruction are of two types: the so-called typical biological station which is equipped to offer both instruction and research, and the biological nature camp which is devoted almost wholly to instruction. In giving instruction, both kinds of institutions must solve certain problems attendant to the course work, in addition to those of equipment and living facilities. They must secure an adequate staff of instructors. They must evolve an educational philosophy to decide the course work to be given and the organization of the actual teaching. They must decide on the actual courses to be offered. They must solve a series of administrative problems related to curriculum practices, academic credit, tuition, and scholarships. Lastly, they must occasionally analyze the students they attract in order to compare the product of instruction with the aims of instruction.

*The Teaching Faculty.* — About 350 persons are engaged in teaching activities at the various biological stations each year. While some of these institutions have only one faculty member (*e.g.*, Summer School of Bry-

ology), the Marine Biological Laboratory has twenty-six. The average number of faculty members for those stations which do have formal instruction is between three and four.

*Education, Academic Position, and Specialization.* — Three out of four faculty members of biological stations in continental United States have their doctor's degree, and this figure is higher for those faculty members at the field stations of most other countries. A few stations have no faculty members with doctorates (*e.g.*, Lake Enemy Swim Biological Station), while the entire faculty of several of the larger field stations do have their doctor's degrees (*e.g.*, Scripps Institution of Oceanography).

The majority of faculty members are university professors, although their occupations during the period of the year in which the station is not in session vary from that of a retired high school teacher (*i.e.*, Dr. A. J. GROUT of the Summer School of Bryology) to a United States National Park Naturalist (*i.e.*, C. A. HARWELL of the Yosemite School of Field Natural History).

The majority of the faculty members of biological stations are zoologists. Among the fields of specialization other than general zoology, botany, and biology of the faculty members may be included oceanography, nature education, geology, meteorology, and astronomy.

*Institutional Inbreeding and Faculty Turn-over.* — During the regular academic year a large proportion of the faculty at biological stations is attached to the institution which sponsors the station. This is a type of institutional inbreeding. In the United States, this practice varies from one hundred per cent (*i.e.*, Oceanographic Laboratories of the University of Washington) to none, especially in those field stations which are autonomous and therefore do not have parent institutions. While it is often easier for a field station to employ faculty members attached to its sponsoring institution, a more qualified staff can often be obtained at least partially from outside institutions.

In order to prevent complete inbreeding of their faculty, several of the biological stations of the United States make a practice of employing instructors from outside institutions for one or several seasons. One station with eleven faculty positions has had seven of these filled by different persons in a space of four years. Another station (*i.e.*, Michigan State College School of Field Biology) with a faculty of three, has not had a change in its staff for a period of eleven years.

A frequent change of faculty members does not usually increase the quality of instruction, even though it may bring in a new point of view for a time. Some of the best instruction at these institutions is given by those persons who have taught at one station for many years, since most field instruction demands as much knowledge of the particular environment around the station as of the subject-matter itself. Yet while a slow faculty turn-over is a definite asset to the quality of instruction at many of these institutions, continuous teaching at any one station might retard the scientific progress of a particular instructor. This whole problem of faculty turnover is one which few stations have answered successfully. One method of solving this problem has been the granting of a periodic leave of absence to

the instructor and then keeping his position on the staff unfilled for the period he is absent from the station.

*Teaching Load.* — It is not easy to calculate the average teaching load of faculty members while in residence at biological stations because the teaching load is a function of the instructor's philosophy and method as well as of the actual number of students, courses, or credits for which he is held responsible. Of forty-nine United States stations, each faculty member in general is responsible for about seventeen students, although this varies from almost six students for each faculty member of the Marine Biological Laboratory to a theoretical number of sixty students for the one faculty member of the Laguna Beach Marine Laboratory.

The average number of courses each faculty member teaches is often a better criterion of teaching load than the average number of students, because course enrollments differ as widely within field stations as within colleges or universities. At the typical field station the instructor is responsible for teaching one course which, in the United States, averages between four and five academic credit hours of work. This figure varies from one-fifth of a course for each instructor (*i.e.*, New Hampshire Nature Camp) to three courses for the instructor (*i.e.*, Merriconn Biological Laboratory).

The average teaching load of most faculty members at field stations is such that they spend more than one-half of their time in teaching. The remainder of their time is spent in their own research or in supervising the investigations of advanced students. Most of the faculty members of American stations bring their wives and children with them to live at the station and they spend, therefore, a portion of their time with their families.

*Educational Philosophy.* — Once a biological field station has decided to offer formal instruction, it must next evolve an educational philosophy to determine the type of course work that it will give. Field stations have, in general, followed one of two educational philosophies, although the majority of stations offering formal instruction combine the two concepts as much as they are able.

One type of station has adhered to an educational philosophy of offering only advanced instruction, especially for persons preparing to receive advanced degrees or to become research investigators. While the Marine Biological Laboratory is perhaps the outstanding example of such an institution, at least twenty-five other stations adhere to this policy.

The opposite practice is that held by the biological stations which believe that field instruction should be of an elementary nature. This type of station, of which almost all are in the United States, offers only elementary courses for public school teachers and undergraduate students who have neither the desire nor the training for extreme specialization.

That both philosophies of instruction at biological stations have a legitimate appeal may be seen from the fact that more than one-half of the biological stations of the world which do offer instruction are prepared to give courses both to elementary and to advanced students. And in actual practice, the instruction at biological stations is not only determined by their educational philosophy, but also by their location, the instructors available, and the potential student-body.

*Advanced Instruction.* — The biological stations which offer only advanced course work are located from Finland to Algeria, from Maine to the southern part of California. The actual course-work offered by these institutions is often of a very advanced nature (*e.g.*, advanced invertebrate embryology at the Oceanographic Laboratories of the University of Washington), although several are intermediate courses and may be taken with only one previous course in the biological sciences (*e.g.*, entomology at the University of Michigan Biological Station). The biological stations which offer only advanced instruction may often be distinguished more by their admission requirements than by the courses they offer. Graduate and occasionally upper-class undergraduate students are admitted to these institutions. Yet even students of these ranks may take certain courses only after fulfilling certain prerequisites.

*Elementary Instruction.* — At least eighteen biological stations offer only elementary instruction. These institutions are, with the exception of the Helgoland Bird Observatory, located in the United States. The courses given at these institutions are usually in the fields of nature study and the pedagogical training of nature-study teachers. The requirements for admission to these institutions are minimal, for the purpose of instruction is generally to engender an appreciation and understanding of the outdoors by means of field trips and observations. Several institutions in this category are particularly interested in training special groups of persons, as teachers in nature study (*i.e.*, West Coast School of Nature Study) and leaders of nature recreation (*i.e.*, Virginia Natural History Institute Nature Leaders' Training Course).

*Combined Instruction.* — A majority of the biological stations which consider at least a portion of their function to be instruction offer course work to both advanced and elementary students. These institutions believe that both the beginning and advanced student may receive inspiration and instruction by being at the same biological station, if not actually attending the same courses. The actual courses at these stations vary from those of a very elementary nature (*e.g.*, man and the living world at the Isles of Shoals Marine Zoological Laboratory) to advanced ones with many hours of prerequisites (*e.g.*, parasitology at the Lake Itasca Forestry and Biological Station).

The requirements for admission to these biological stations which offer both elementary and advanced instruction are relatively flexible. In general, the requirements depend more upon the actual courses to be taken by the student, than by his general academic rank. Some of these stations (*e.g.*, Allegany School of Natural History) are open to "gifted high school students" and others (*e.g.*, Lake Itasca Forestry and Biological Station) are "open to all qualified graduate students who have had the usual preliminary courses in biological subjects." The purpose of the instruction given by institutions in this category also varies from fulfilling part of the science requirements of "pre-professional students, such as pre-medical, pre-dental" (*i.e.*, Isles of Shoals Marine Zoological Laboratory) to assisting "persons interested in the study, collection and determination of particular groups of animals and plants" (*i.e.*, Oregon Institute of Marine Biology).

*The Courses.* — About two hundred and fifty courses are given by those biological stations which offer some kind of formal instruction. Each institution offers an average of three courses a year, although the majority of stations give only one course. The American stations tend to offer more courses than those in other countries. One American station (*i.e.*, Lake Itasca Forestry and Biological Station), offers eighteen courses, while the largest number of courses given by a station located outside the United States is six (*i.e.*, Marine Biological Station of the Tôhôku Imperial University). Those stations offering only elementary instruction tend to give the fewest number of courses, while those which give only advanced instruction offer the greatest number of courses, perhaps because of the specialized needs and interests of advanced students.

*Sciences Represented.* — Most of the courses offered by biological stations are naturally in the biological sciences. While the largest number of courses are offered in zoology, the proportion varies from almost less than one-half for the stations in the United States to less than one-fifth for those institutions in other parts of the world. The inclusion of courses not within the traditional limits of zoology, botany, or biology indicates that these institutions fully realize the need of exploring, by instruction as well as research, the borderline fields between biology and the social sciences (*e.g.*, nature education) and biology and the physical sciences (*e.g.*, marine meteorology). Another need felt and realized at several stations is the integration of both the physical and biological sciences into one field course at an elementary level (*e.g.*, nature study).

A classified list of the general fields in which course-work is offered at one or more biological stations follows: protozoology, invertebrate zoology, helminthology, entomology, ichthyology, ornithology, vertebrate zoology, field zoology, animal ecology, economic zoology, parasitology, embryology, comparative anatomy, algology, mycology, bryology, taxonomy of higher plants, field botany, dendrology, plant ecology, plant physiology, plant anatomy, plant morphology, plant histology, limnology, marine biology, general ecology, general physiology, microbiology, wild life conservation, biochemistry, paleobiology, oceanography, nature study, nature education, geology, meteorology, chemistry, seismology, astronomy, and geography.

*Types of Courses.* — Instruction at biological stations probably first arose when college and university professors realized they could not teach successfully about marine life a hundred or thousand miles away from the sea. Instruction was first given at biological stations in subjects which could not be thoroughly or scientifically taught (*i.e.*, by observation and/or experimentation) in the ordinary college or university campus laboratory located often miles from a forest and even further from fairly uncontaminated seashore. Thus the first subjects to be taught at field stations were *1*, the taxonomy of biological forms, for the whole kingdom (*e.g.*, plant taxonomy), for a special area (*e.g.*, botany of the Alps), or for a special group (*e.g.*, bryology); and *2*, the ecology of biological forms, either for a whole kingdom (*e.g.*, animal ecology), or for special environments (*e.g.*, limnology).

As the research programs of biological stations became increasingly concerned with physiological problems, courses in physiology were given

at these institutions. At first these courses made good use of the living organisms in the field station environment. This departure, however, from the traditional type of course-work at field stations perhaps helped to lead to the initiation of a whole series of courses offered by these institutions which had less and less relation to the environment in which they were located. Courses such as cell morphology, experimental surgery, and histology-embryology appear in the catalogues of contemporary stations. Today students often go long distances to attend a field station which offers a course in a subject which may perhaps be better taught at a well-equipped university campus in the center of a large city.

There are several reasons for the introduction of these so-called "laboratory" courses at field stations. Some laboratory and lecture courses have been given frankly to attract a sufficient number of students to make the continuance of the station and especially of its field program possible. Such courses, for example, have often been for pre-medical students, the latter actually subsidizing the courses offered by the institution in the less popular "field" subjects. A second reason for the introduction of courses often unrelated to the station's biological environment is found in the station's research program. Several stations are avowedly more concerned with research than with instruction. The teaching they do offer is quite secondary and dependent upon both the station's research program and the staff members available as instructors. Thus the Biological Laboratory of the Long Island Biological Association offers a course in experimental endocrinology because it is one of the spheres of research upon which the laboratory has decided to concentrate; also, a member of this station's staff is perhaps more qualified to teach this subject than one more related to the environment in which the station is located. Other reasons for the offering of laboratory courses at field stations, in the words of station officials, are "we can get better work out of the student" and "there is a need for these courses and they are given nowhere else."

Another trend is the use, at some stations, of indoor laboratory methods even in field courses which may best perhaps be taught with so-called outdoor methods. Dr. Charles C. Adams once commented, "I have known of cases where the *field* school merely repeated the city class work, only using fresher material than in the city, and without the slightest idea that this was not a sane procedure"[1]. Such observations have caused some American biologists to believe that their students can often obtain better field instruction and experience from courses on several university campuses not too removed from "the field," than at some biological stations even in isolated places.

*The Subject Matter.*—While some courses offered by different biological stations may have the same titles, their subject matter often differs greatly. This divergence is most often due to the location of the station and to the training of the instructor, although the educational philosophy of both the station and instructor are important contributing factors. Because of their small classes, biological stations can be remarkably sensitive to the needs of their students. The courses given are often markedly altered once the instructor knows the wishes of the students actually registered in any course in a given year.

*Administrative Problems.* — The instruction at biological stations is most often organized into one, short session, beginning in June. Three-quarters of these institutions which give instruction offer it at only one session a year. Those stations which offer more than one session do so because of limited classroom facilities (*e.g.*, Zoological Station of the Netherlands Zoological Society), because of the desire to give instruction at different times of the year (*e.g.*, West Coast School of Nature Study), or in order to give instruction in different localities (*e.g.*, Oglebay Institute Nature Leaders Training School). The largest number of sessions is offered by the Audubon Nature Camp. This institution gives five two-week sessions each summer, the desire being to train a large number of students rather than to teach one-fifth the number five times as long.

The length of the sessions at biological stations ranges from one week to nine. Almost one-third of the sessions are two weeks in length, while about one-fifth are for a six-week period. The shortest sessions are usually conducted by nature camps, while the longest ones are at those stations offering only advanced instruction.

The time of the year when instruction is given at biological stations depends upon a number of factors, of which the flora and fauna, the students, and the faculty are most important. Instruction can only be given at those times of year when the desired animal and plant forms can be adequately studied in the field. Instruction in alpine botany, for example, can usually not begin before July in the Alps, whereas marine biology may best be studied along New England during August. The time of the year when students and faculty members are normally free from their regular college or university studies limits instruction at biological stations to the summer vacation in the northern hemisphere. The stations in France and England, however, have long made a practice of offering courses during the universities' Easter recess in April. This is a time which is fairly favorable for the study of marine biology in those countries in Europe and it is also during the student's term at the university — an advantage because the student can closely relate the field biology learned at the station to the laboratory biology studied at the university. The West Coast School of Nature Study is the only institution in the United States which has recently attempted to give a session during the Easter recess.

June and July is the period of the year during which the greatest number of sessions is given. October is the latest month in the year that a course is offered at any biological station (*i.e.*, at the height of the autumn bird migration season a course in ornithology is given at the Rossitten Bird Observatory).

*Academic Credit.* — In biology as well as in most other subjects, contemporary university students, especially in the United States, not only take courses for the knowledge they receive, but also for the credit they may obtain toward an academic degree. For this reason biological stations have found it expedient to offer college credit for formal course work completed by students at these institutions.

In the United States, about four-fifths of the biological stations offering instruction have made arrangements for students satisfactorily completing course work to obtain credit. Those field stations which are directly spon-

sored by colleges and universities have the privilege of granting credit because of their connection to these institutions of higher learning. Biological stations which are sponsored by institutions other than colleges or universities, or are only partially sponsored by them, often make arrangements whereby work done at them is recognized by some nearby or affiliated college or university and is thus transferable to other such institutions throughout the country. Some autonomous field stations use similar procedures to obtain credit for their students. Ten field stations in the United States do not offer academic credit. These range from institutions which offer instruction of a very advanced nature (*e.g.*, Marine Biological Laboratory) to those stations where the instruction is very elementary (*e.g.*, Green Mountain Nature Camp).

*Tuition and Scholarships.* — Students are assessed tuition fees at most biological stations. These fees are usually for instruction, and sometimes include scientific supplies and transportation on field trips. The average tuition at forty-six biological stations is the equivalent of $28.82. Tuition costs range from $1.00 at the Nature Enjoyment Camp to $75.00 at the Marine Biological Laboratory. This variation is due to a number of factors, the most evident of which is the length of the session. A base for comparing the tuition is, therefore, that charged students per week. This ranges from $.35 weekly at the Zoological Station of Tvärminne to $14.25 weekly at Science of the Out-of-Doors. The average weekly tuition is $5.73, the amount being $4.57 for the ten stations outside the United States about which information on the cost of tuition is stated.

At least fourteen biological stations regularly charge no tuition fees. More than four-fifths of these are outside the United States. A number of stations in the United States, however, offer tuition scholarships for students who desire a diminution of fees either because of their scholastic excellence or financial distress. These scholarships are either offered directly by the administration of the station or by organizations interested in the work that the station is doing (*e.g.*, two partial scholarships for students at the Allegany School of Nature History have been provided by the Burroughs-Audubon Nature Club of Rochester, New York).

*The Student Body.* — Instruction is given at biological stations for the benefit of students who take the formal course work. The type of instruction offered is determined by the educational policy of the institution. At a number of the smaller stations, however, it has been expedient to determine this policy only after considering the desires of the potential and actual student body of the station. This has necessitated a systematic estimation if not an actual survey of the students who are attracted to each station. Another use made of such an estimate is to ascertain to what degree the student body, as the product of instruction of a station, compares with the educational aims or assumptions of the institution.

The student body at most biological stations is characterized by its heterogeneity. The students at any biological station, as at many other types of educational institutions, may be found to vary in their sex[2] and age, in their race[3] and nationality[4], in their training and occupation, and in their institutional connections. Thus persons enrolled in course work at many

larger stations include college professors and high school seniors, women interested in becoming nature counsellors and men training for research in theoretical science.

*Public Education.* — *Aquariums.* — In the nineteenth century, public aquariums were often associated in the public mind with biological stations. Even today thirty-four of these institutions maintain public aquariums. Many of these were built during the nineteenth century. While this tradition of maintaining aquariums associated with biological stations is strong in many parts of the world, it is not so in the United States. Only two United States biological stations possess these displays (*i.e.*, Scripps Institution of Oceanography and the Fisheries Biological Station at Beaufort, North Carolina).

While those biological stations which do have public aquariums are naturally concerned with public education, many incorporate aquariums into their function as a means of subsidizing the research work of the station. This plan was first conceived by Dr. ANTON DOHRN and today the number of visitors (and thus fees) received by the larger aquariums is substantial. The annual number of visitors to the aquariums of several large stations is as follows: 180,000 at Monaco in 1938, 73,260 at Helgoland in 1937, 40,000 at Naples in 1937, 43,045 at Port Erin in 1938, and 32,000 at Plymouth in 1937. To supplement the observations of the public at these larger aquariums, elaborate manuals describing the biological forms exhibited are often issued.

*Museums.* — These institutions are also occasionally sponsored by biological stations for public education. Most are marine museums associated with marine aquariums. Other types include museums of systematic biology (*e.g.*, The George M. Gray Museum of the Marine Biological Laboratory) and outdoor field museums (*e.g.*, Outdoor Museum of the Allegany School of Natural History).

*Botanical Gardens.* — Especially in alpine regions, botanical gardens are operated in conjunction with biological stations. Eleven stations have such public botanical gardens. In addition to alpine gardens, there are tropical gardens (*e.g.*, Foreigner's Laboratory at Buitenzorg) and Indian gardens and nature trails (*i.e.*, Allegany School of Natural History).

*Public Lectures.* — Laboratory tours and public lectures are sometimes included among the public education features of biological stations. The Allegany School of Natural History, for example, scheduled a series of popular evening lectures once each week during the period that it was in session. This attracted a number of interested persons from the vicinity. Visiting days are also inaugurated at these institutions, both as educational features and to concentrate visits (and thus limit distractions) from the public to one day of each session.

*Notes:* — (1) From a letter, dated March 25, 1940, to the author. — (2) Although most biological stations today admit women students, co-education was a debatable subject when these institutions were first established. LOUIS AGASSIZ, however, had no misgivings about allowing women to register as students in the Anderson School of Natural History. He once stated, "As soon as the number of students was limited, we determined a question of no small moment,—whether ladies should be admitted. In my mind I had no hesitation from the start. There were those about us whose opinion I had to care for but did not know, so I thought the best way was not to ask it, but

to decide for myself." *Cf.* American Naturalist 32:189-96, 1898. — (3) Both colored and white persons are generally admitted as students and investigators at biological stations. The late Dr. Ernest E. Just, famous Negro biologist, spent many years at Woods Hole (*cf.* Science 95:10-11). The few biological stations located in the Southern United States do not admit Negroes. These stations feel they must follow the unjust mores of their region rather than lead in the *application* of scientific truth as they lead in the *investigation* of scientific truth. — (4) The student bodies of biological stations do not tend to be as international as the investigators at these institutions often are. The language barrier is one reason for this, since a person studying formally in a foreign country must be a better linguist than one doing research work. Another reason is that the course work at biological stations is generally duplicated at these institutions in many countries. There is not, therefore, the urgent need to cross national frontiers for course work as there is to do so in order to carry out investigations with rare forms or in unique environments. A third reason for the small proportion of foreign students at most biological stations, compared to the number of foreign investigators, is that most biologists have not attempted to excel as teachers. While an investigator might cross the ocean to work under the direction of a noted scientist, a person is less inclined to do so as a student, because there are fewer outstanding scientists with whom he may work at a biological station as a beginner. In certain instances, however, some foreign students may be found taking courses at biological stations. Systematic efforts should be made to facilitate the exchange of biological station students across international borders.

**Research at Biological Stations:** — Research is one of the primary functions of biological stations. Almost nine-tenths of these institutions offer research facilities. These are available to three types of persons: staff investigators, independent investigators, and student investigators. Several stations are prepared to accommodate all types, while others receive, for example, only independent investigators. Whatever the practices of the stations devoted to research, each type of investigator accommodated demands certain facilities from the station, while it in turn makes certain demands upon the investigator.

In addition to the living facilities and equipment offered to the different types of investigators, many biological stations attempt to furnish certain other opportunities to resident investigators and often also to research workers quite removed from the station. These include facilities for publication, supplies of biological specimens, and scientific symposia and conferences.

*Research by Staff Investigators.* — A portion of the research work done at almost nine-tenths of the biological stations is carried on by staff members of these institutions. The remaining stations either offer formal instruction exclusively, or are only prepared to offer facilities to visiting, independent investigators. The staff investigators who do pursue research problems are either permanent or part-time members, the latter often also giving formal instruction or supervising student research at the station.

Almost one-half of the biological stations maintain a permanent research staff. This practice varies with the customs of the countries in which these institutions are located. All of the Russian stations, for example, have a permanent staff, while none of the Algerian stations do. The larger countries with a high proportion of the field stations maintaining a permanent staff include Italy, Spain, Germany, and England. Those countries with a low proportion of stations with a permanent research staff have a complementary high proportion of stations with part-time staff investigators.

*Permanent Staff and Program.* — More than one hundred biological stations have a permanent, year-round staff. The actual number of staff members at these institutions varies from fifteen (*i.e.*, Scripps Institution

of Oceanography) to one (*e.g.*, Danish Arctic Station). The staff of more than one-half of these stations is composed of only one or two members. Only seventeen stations have five or more members of their permanent research staff. In addition, most of the larger stations have a number of full-time laboratory technicians, assistants, and administrative employees (especially librarians) who all aid in the research output of the institution.

The field stations which do have permanent staffs either do research on general biological problems or, due to sponsorship or location, concentrate their work in certain fields. Almost one-third of the stations specialize in research in marine biology. Other major fields of specialization at these institutions include fresh-water biology, fisheries, and oceanography.

Research institutions, especially in the more theoretical sciences, have often failed to bring about the coordination of personnel to the degree which some think to be necessary to make for the greatest efficiency in research. While this is often due to limited funds and equipment, it is perhaps equally due to lack of tradition for a type of teamwork in theoretical science that is comparable to that accomplished by the more practical scientific research institutions. At most biological stations with a permanent staff, the investigators — although staff members — work quite independently and their problems have little relation with each other. At a few biological stations, however, and especially at those dealing at least in part with applied biology, there is more of a closely correlated research program. There are evidences, too, that this coordination is slowly spreading to more biological station research programs.

The actual research programs of biological stations are too diverse for adequate generalization.[1] It may be said perhaps that these programs have attempted to keep abreast of the general trends in biological research, although some have lagged behind while others have pioneered for the science as a whole.

*Part-time Staff and Program.* — More than one hundred biological stations have a part-time staff of investigators. These persons are usually expected to do research during the period of the year that they are attached to the station or to do as much research as they are able after giving formal instruction or supervising student research at the station. The number of staff members of these institutions varies from twenty-two persons (*i.e.*, Marine Biological Laboratory) to one (*e.g.*, Royal Hydrobiological Station of Lake Trasimeno). Almost two-thirds of these stations have only one or two investigators, and the average part-time staff consists of three members. Twelve stations have five or more staff members, and ten of these are located in the United States. In addition to staff investigators, these institutions also employ part-time laboratory assistants and technicians to aid the investigators with the more routine laboratory and field tasks.

The biological stations with part-time investigators have less of a specialized research program than even those institutions with permanent staffs. The specialization of almost one-half of these biological stations with part-time staffs is due to its location either on fresh bodies of water or on the sea, while an additional one-third of these institutions pursue a research program in general biology. A few of these stations center their researches around such special fields as botany, ecology, or fisheries.

If the research program at those biological stations with a permanent staff is often uncoordinated, that at the institutions with a part-time staff is generally more so. Frequently the part-time investigator, although invited to undertake research work at the station, is also expected to supervise student research and give formal instruction. In such cases, whatever research the investigator does is secondary to any research program the station may have. The part-time staff member becomes, in reality, an independent investigator whose laboratory and often living fees are met by the station. The result is that the investigator spends his time completing previous research or inaugurating a project of his own interest which is often unrelated to that of his colleagues at the field station. A few of the institutions with part-time investigators do, however, have a well-correlated research program. This is due either to the part-time staff spending its full time in research or, less frequently, the retention of the same investigator year after year — a procedure not commonly adopted by most stations.

While stations in this category are characterized as institutions with a part-time staff, this does not necessarily mean that they are closed for a portion of the year. About one-quarter of these institutions are open throughout the year. Such stations may be open to staff investigators on a twelve-month basis, but the investigators are only hired on a part-time arrangement.

*Research by Independent Investigators.* — More than nine out of ten biological stations offer research facilities to independent investigators. Of the institutions which do not, a majority are biological nature camps which are concerned usually with elementary instruction. A few institutions do not admit visiting investigators because their limited budget can accommodate only members of their permanent staff (*e.g.*, Pacific Biological Station) or because the station is in the process of organization and has no facilities to offer visiting investigators (*e.g.*, Rocky Mountain Biological Station of the University of Michigan).

The biological stations which offer facilities to visiting investigators have various conditions for their admittance. Some institutions admit investigators in any biological subject quite unreservedly and with few formalities. Other stations carefully review the qualifications and proposed research program of the applicant and then he or she is admitted only if the research project coincides with the general aims of the station. In general, all stations at least want to know the problem the investigator will pursue and the time of his arrival, so they can better prepare for his investigations.

After the independent investigator is admitted to a biological station, he may or may not be assessed laboratory fees. More than one-half of the biological stations do not charge fees. About one-fifth of the institutions have laboratory fees which range from five to fifteen dollars a month, while another one-fifth charge monthly fees equivalent to more than fifteen dollars. The most expensive fee is one hundred dollars a month (*i.e.*, Mount Evans Laboratory).

A method whereby a field station obtains income from the facilities it offers, yet not from the individual investigator, is the so-called table system. This is believed to have been inaugurated by the Zoological Station of Naples. It has been adopted, with some alterations, by other institutions[2].

As the laboratory fees or table arrangements differ, so do the facilities which biological stations put at the disposal of the visiting investigators. Some of the smaller stations permit the investigators to use whatever equipment is available. Others attempt to give the research workers as much complicated apparatus and as many special solutions as the institution can afford. In addition, stations often supply the investigators with fresh animal and plant forms daily, if required. The facilities offered to investigators and the procedures by which they may be obtained are often codified in the form of laboratory rules.

In addition to laboratory facilities, visiting investigators are often given certain concessions by virtue of their connections with some biological stations. Occasionally they are privileged to bring scientific apparatus into the country in which the station is located duty free (*e.g.*, Zoological Station of Naples). Some stations obtain reduced transportation rates for research workers (*e.g.*, Bermuda Biological Station for Research, Inc.). Other stations which are not able to provide full living facilities to investigators also may obtain reductions in living costs at nearby hotels or restaurants for them (*e.g.*, Jungfraujoch Scientific Station).

In furnishing laboratory facilities to independent investigators, biological stations do so with the implied agreement that the worker will do his best to contribute to the progress of science. Most stations ask no more of the investigator. Some of these institutions, however, expect that the investigator will partially repay the station in one of several tangible ways. These include identifying animal and plant forms, acknowledging indebtedness to the station in printed reports of any work done at the station, compiling a separate report of research undertaken, and donating reprints of any published research to the station library.

The number of investigators who take advantage of the facilities offered by biological stations varies with the time of the year and — over longer periods of time — with economic and international conditions. About three-quarters of the stations which offer facilities to investigators of this type are open throughout the year. As only a few independent investigators are on year-round fellowships or sabbatical leaves of absence, the summer months or short periods at Easter recess are the only time that the majority of research workers are able to make use of these facilities. As a rule, therefore, many of these stations are crowded in the summer months and — if open at all — are quite empty in winter.

The maximum number of investigators which these institutions can accommodate at any one time varies from two (*e.g.*, Marine Laboratory of the University of Sydney) to more than 250 (*i.e.*, Marine Biological Laboratory). More than two-thirds of these institutions accommodate no more than ten visiting investigators. Those stations which have facilities for more than twenty-five independent investigators include the institutions at Bermuda, Salisbury Cove (Maine), Plymouth, Villefranche, Helgoland, Naples, and Woods Hole (Marine Biological Laboratory).

The actual research work done by the independent investigator at biological stations is often in the field. There are instances, however, where the investigations are carried on exclusively in the laboratory, often with such forms as rabbits and mice. The investigations may be in a phase of theoretical biology or in one of the applied or border-line fields. Some are

life-time problems and others are projects which may be completed in a few weeks.

*Research by Advanced Students.* — Almost one-half of the biological stations are known to be equipped to receive advanced students who desire to do research work under direction. These institutions are, for the most part, stations which offer formal instruction, although in some instances stations devoted exclusively to research provide for the training of research investigators (*e.g.*, Woods Hole Oceanographic Institution). The supervisors of student research are usually faculty members also offering more formal class-work, although they may be permanent or part-time staff investigators who are qualified to direct research by their academic affiliation or attainment.

The conditions under which students are admitted to do research under direction vary considerably. A few stations allow undergraduate students to undertake research (*e.g.*, the Bowdoin Scientific Station is organized primarily for this purpose). Most field stations, however, offer such facilities only to graduate students who are working for a higher degree. Admission requirements in such cases usually coincide with those of the institutions which grant the degree.

Since the research work done at biological stations is often under the official direction of the institution which awards the advanced degree, the fees for such supervision of student research are controlled usually by the university concerned. These do not, however, differ greatly from those charged students taking formal course work. A number of student investigators are subsidized in their studies by fellowships and scholarships granted by the universities to which they are attached. In addition, several biological stations offer special fellowships to advanced student investigators.

The actual research done under supervision at biological stations includes field and laboratory work in many branches of biology. Many of the problems are of a relatively limited scope, often being connected with the larger work or interest of the supervising faculty member. Some of this research is written up as theses in partial fulfillment for advanced university degrees. In other instances, the studies are preliminary.

*Facilities for Publication.* — Biological stations occasionally offer staff and independent investigators opportunities for the publication of the results of their researches. These facilities are in the form of serial publications issued by the field station. A few of these serials are published bi-monthly (*e.g.*, *Biological Bulletin* of the Marine Biological Laboratory), while others are issued annually (*e.g.*, *Bulletin of the Mount Desert Island Biological Laboratory*). A number are issued only occasionally (*e.g.*, *Fauna et Flora Laurentianae* of the St. Lawrence Biological Station).

The material in these publications of biological stations is generally limited to reports of research undertaken at the station (*e.g.*, *Palao Tropical Biological Studies*), although sometimes they include papers reporting investigations conducted elsewhere (*e.g.*, *Der Vogelzug* of the Rossitten Bird Observatory). While most of the material in these serials is the result of scientific work, space is devoted in some of these publications to reports of the general work and financial condition of these institutions (*e.g.*, *Annual*

*Report of the Freshwater Biological Association of the British Empire*). The larger stations are able to separate the types of articles included in these publications by issuing several kinds of serials (*e.g., Thalassia* and *Note* of the Italian-German Institute of Marine Biology).

The oldest serial publication issued by any biological station is believed to be the *Fauna et Flora del Golfo di Napoli.* This was first published by the Zoological Station of Naples in 1880. The most recent serial bulletin to be established by a biological station is the *Publication of the Marine Biological Station, Ghardaqa* (1939). Several well-known publications of biological stations have been compelled, for one or more reasons, to discontinue or at least merge with other journals. These include *Mittheilungen aus der Zoologischen Station zu Neapel* (which became *Pubblicazioni della Stazione Zoologica* after its twenty-second volume), *Travaux du Laboratoire de Zoologie et Physiologie maritime à Concarneau* (which was discontinued during the first World War), and *Wissenschaftliche Meeresuntersuchungen, Abth. Helgoland* (which since June 1937 has been *Helgoländer Wissenschaftliche Meeresuntersuchungen*).

In addition to providing publication facilities to research investigators, biological stations are able to use these serials to obtain similar journals from other scientific institutions by means of exchanges. Those stations which do not publish serials occasionally issue a limited edition of collected reprints of published research work done at the station (*e.g., Collected Reprints* of the Woods Hole Oceanographic Institution). These, too, are frequently used for exchange purposes.

The research papers of investigators at the biological stations which do not publish scientific serials usually appear in the appropriate journals of other scientific institutions or organizations. In some instances, certain journals quite independent of the biological station often receive most of the research papers originating from that station. Thus many articles describing the results of research undertaken at the Zoological Station of Algiers appear in *Bulletin de la Société d'Histoire Naturelle Afrique du Nord.* Often an institution sponsoring a biological station publishes the research work of that station in its scientific publications. Thus many of the researches completed at the Allegany School of Natural History have appeared in the various publications of the New York State Museum which, for some years, was a co-sponsor of that station.

*The Supply of Biological Specimens.* — A method by which biological stations contribute to research and instruction is the collection and sale of preserved and living biological specimens. Some biological stations were organized because biologists for their research and instructional needs were unable to obtain necessary biological forms. Laboratories were therefore set up where these could be more easily obtained. Now some of these very same laboratories are making it possible for biologists to receive living and preserved specimens many hundreds of miles away from the natural environment of these forms.

At least twelve biological stations have well-organized biological supply departments. These include the stations located at Amoy, Plymouth, Wray Castle, Helgoland, Krefeld, Ennur, Naples, Rovigno, Helder, Portobello, Millport, and Woods Hole (Marine Biological Laboratory). Some of these

departments do a relatively small annual business, although that of the Marine Biological Laboratory had a gross income of almost $40,000 in 1938. Most of these supply departments issue some kind of price-list for prospective individual and institutional purchasers.

The disadvantage of this auxiliary service of a biological station is that many of the materials must be collected in the immediate neighborhood of the laboratory. The type of wholesale collecting which it is necessary for most supply departments to do often negates the advantages, both financial and scientific, of operating this service.

*Scientific Lectures and Conferences.* — A method used by a few of the larger biological stations to promote the advancement of science in general is the sponsoring of scientific lectures and conferences. Some stations schedule a series of scientific lectures to be delivered at the station by staff members, visiting investigators, or special lecturers. These talks are sometimes about subjects of general biological interest, while at other times they are on very specialized topics. In both cases, they result in a broadening of the knowledge and interests of those research investigators attending them. Often information on the results of unpublished scientific experiments and observations are divulged for the first time at these talks.

Biological stations are occasionally hosts to various biological symposia, conventions, and congresses. The Symposia on Quantitative Biology of the Biological Laboratory of the Long Island Biological Association are perhaps the most noted of such conferences to be sponsored by field stations in recent years. While this symposium has been inaugurated by the station and is an annual event, others are organized by independent scientific organizations and convene at the biological station for only a single occasion. When the Fourth Pacific Science Congress met in Java in 1929, the Visitors' Laboratory at Buitenzorg was host to many visiting botanists. In North America, the Genetics Society has held summer meetings at the Marine Biological Laboratory for several years. Such conferences at biological stations often introduce students and investigators to the visiting scientists and they, in turn, are introduced to the work and potentialities of the station.

*Notes:* — (1) A splendid account of the research program for the first twenty years at one station is given by FRANK R. LILLIE: The Woods Hole Marine Biological Laboratory. University of Chicago Press, pp. 115-56, 1944. — (2) These table systems have helped to make possible the international exchange of investigators at biological stations. Few systematic attempts have been made in peacetime to overcome the normal difficulties of foreign research and thus facilitate the interchange of investigators.

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The following directory brings together information on 271 biological stations in fifty-nine political areas. The description of each station has been necessarily limited to fit within the format of this study. An attempt is made, however, to give at least the following enduring facts about each station: the location, the name, the sponsoring organization, the purpose, the unique equipment, and the name of its scientific publications. Less often information is given on the biological surroundings of the station, the date of foundation, and the time of year the station usually has been open (if

normally closed for a portion of the year). Occasionally less permanent but often indicative information is given, such as the annual budget, the name of the director, the number of resident scientific investigators, the type and size of boats, and a description of the course work offered. No attempt is made to give the most recent information available on the names of staff members, the number of menial employees, the size of the library, the cost of board and lodging, the maximum number of students accommodated, tuition costs, and the fees assessed independent investigators.

An attempt is also made to give for most stations a fairly complete listing of existing bibliographic references to descriptions of them and their facilities. Space has not been sufficient to give the titles, authors, and dates of these articles, but for convenience the references are listed in chronological order (the first given being the oldest). Perhaps the most consistently useful descriptions of many of these institutions are found in the previous, older catalogues of biological stations. These have been abbreviated in this directory as follows:

Chronica Botanica....Chronica Botanica Co. Leyden, Zuid-Holland and Waltham, Massachusetts. Vol. I (1935) *seq.*

DEAN 1894....DEAN, BASHFORD. Notes on marine laboratories of Europe. Report of the Smithsonian Institution for 1893:505-19, 1894.

JUDAY 1910....JUDAY, CHANCEY. Some European biological stations. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 16:1257-77, 1910.

KOFOID 1910....KOFOID, CHARLES ATWOOD. The biological stations of Europe. United States Bureau of Education Bulletin 1910(4):1-360, 55 pls., 48 figs. 1910.

LENZ 1927....LENZ, F. Limnologische Laboratorien. Handbuch der Biologischen Arbeitsmethoden 9, 2(1):1285-1368, 1927.

MAGRINI 1927....MAGRINI, G. Instituts et laboratoires s'occupant de l'étude de la mer. Conseil International de Recherches, Union Géodésique et Géophysique Internationale, Section d'Océanographie, Bulletin 7:1-115, 1927.

RICKER 1937....RICKER, W. E. Glimpses at fishery biology and fish culture in Europe. Progressive Fish Culturist 31:29-33; *Ibid.* 32:12-15; *Ibid.* 34:12-14, 1937.

SAND 1898....SAND, RENÉ. Les laboratoires maritimes de zoologie. Revue de l'Université de Bruxelles 3:23-47, 121-51, 203-35, 1898.

SCOURFIELD 1905....SCOURFIELD, D. J. Fresh-water biological stations. Jour. Quekett Micro. Club II, 9(56):129-36, 1905.

Turtox....General Biological Supply House. Biological field work. 1928-32, 1934, 1935, 1937. Chicago, Illinois.

VAUGHAN 1934....VAUGHAN, T. W. Catalogue of marine stations of the Pacific. International Commission on the Oceanography of the Pacific, Report of the Chairman. Fifth Pacific Science Congress Proceedings 1:361-80, 1934.

VAUGHAN 1937....VAUGHAN, T. W. Catalogue of institutions engaged in oceanographic work. In International aspects of oceanography. (T. W. VAUGHAN and others.) 225 pp. Washington: National Academy of Sciences. 1937, pp. 73-225.

# DIRECTORY *of* BIOLOGICAL STATIONS

It must be re-emphasized that, with few exceptions, the descriptive accounts given here are corrected to 1940—before World War II became world-wide. As the war progressed, many of these institutions curtailed their activity and some even suspended operation. Despite these changes wrought by the war, it has been thought useful for biologists and others to have a picture of these institutions at perhaps the peak of their operation (1939-40)*.

## — *ALASKA* —

*Little Port Walter* (Baranof Island): **Field Laboratory of the United States Fish and Wildlife Service:** — About 18 miles from the open ocean, with one stream flowing into the bay and that originating in a series of mountain lakes. Established in 1941 by the U.S. Fish and Wildlife Service for the study of the natural reproduction of pink salmon. Laboratory and living facilities are available for visiting biologists. — *Cf.* Science 94:295.

## — *ALGERIA* —

*Algiers:* **Station Zoologique d'Alger:** — Founded in 1888, this institution is conducted by the Faculty of Sciences of the University of Algiers. There is a two-story laboratory building. — *Cf.* La Nature 16(2):327-30; SAND 1898; VAUGHAN 1937.

*Beni Ounif:* **Laboratoire de Biologie Saharienne:** — Situated in a stony desert near a date palm oasis and ten miles from the mountains of Morocco. Founded in 1930 and attached to the Faculty of Sciences of the University of Algiers. The building contains four laboratories and a herbarium. — *Cf.* Chronica Botanica 1938.

*Maison-Carrée:* **Station Botanique de Maison-Carrée.**

## — *ARGENTINA* —

*Quenquén:* **Estacion de Biología Marina del Museo Argentino de Ciencias Naturales de Buenos Aires.**

## — *AUSTRALIA* —

*Cronulla* (New South Wales): **Commonwealth Fishery Research Laboratories:** — Sponsored by the Council for Scientific and Industrial Research of the Commonwealth of Australia. There are two large, well-equipped laboratory buildings. Two-ton truck available as a mobile laboratory for coastal work. Several large boats available, including 82-foot, 138-ton M. V. Warreen. — *Cf.* Nature 144:312-13; VAUGHAN 1937.

*Narrabeen* (New South Wales): **Biological Field Station of the Sydney University Biological Society:** — Founded in 1934 and sponsored by the Sydney University Biological Society. In a suburb of Sydney, where there are laboratory and living accommodations. — *Cf.* Nature 134:602, 623; Chronica Botanica 1:81; *Ibid.* 2:73.

*Port Jackson* (New South Wales): **Marine Laboratory of the University of Sydney:** — Situated in Sydney harbor and equipped for research and instruction in marine biology and oceanography. Sponsored by the Department of Zoology of the

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* Beyond the scope of this directory are accounts of the numerous biological stations of the past (*cf. supra*, p. 10-11). — Dr. VERDOORN has expressed his willingness to publish a historical account of these stations. Much material concerning them may be found in my manuscript thesis (*cf. supra*, p. 5). In the CHRONICA BOTANICA ARCHIVES there is a file of several thousand cards dealing with the history of botanical gardens, museums, etc. This includes quite some data concerning early biological stations (*cf.* CHRONICA BOTANICA 8: 445).

University of Sydney with funds contributed also by the Australian Research Council and the Commonwealth Council for Scientific and Industrial Research. 13-ton auxiliary yacht with oceanographical apparatus available. — *Cf.* Science 74:202; VAUGHAN 1934; VAUGHAN 1937.

## — *BELGIUM* —

*Ostend:* **Institut Maritime de Belgique:** — Founded in 1900, reorganized in 1935 and now connected with the Royal Museum of Natural History of Brussels. — Research published in Annales de l'Institut Maritime de Belgique. — *Cf.* VAUGHAN 1937.

*Rouge-Cloître* (Brabant): **Laboratoire de Biologie Lacustre.**

*Sourbrodt:* **Station Scientifique des Fagnes:** — Located in the bogs of the Belgian Ardennes at an altitude of 2,211 feet. Founded in 1928 by the University of Liège and under the supervision of Professor RAY. BOUILLENNE. The station is open normally from June to October and both laboratory and living accommodations are available. — *Cf.* Bull. Soc. Roy. Bot. Belg. 58:20-24; Chronica Botanica 1:93; *Ibid.* 2:85.

## — *BERMUDA* —

*St. George's:* **Bermuda Biological Station for Research, Inc.:** — Founded in 1903 at Flatts, Bermuda and moved to present location in 1932. Sponsored to offer facilities for research in biology and oceanography in the Bermuda region by an international board of trustees on which are representatives from Bermuda, England, Canada, and the United States. The 12-acre plant includes complete laboratory and living facilities. Oceanographic research vessel, Culver, attached to the station, as is a 24-foot launch. Investigators may obtain reduced steamship rates and exemption from paying customs on their scientific supplies and equipment. — *Station publications:* report of the officers; contributions, Bermuda Biological Station for Research, Inc. (1931- ); and Collected Reprints, Bermuda Biological Station for Research, Inc. — *Cf.* Chambers Jour. 6(7):783-84; Pop. Sc. 66:393-411, 556-72; Science 65:128-30; *Ibid.* 73:488-89; *Ibid.* 75:133-36; Nature 139:948-51; Science 89:28; *Ibid.* 94:319; Chronica Botanica 1935; *Ibid.* 1936; *Ibid.* 1938; Turtox 1937; VAUGHAN 1937.

## — *BRAZIL* —

*Alto da Serra:* **Estação Biológica do Depto. de Botânica do Estado:** — Near São Paulo at an altitude of 2,400 feet, in a virgin sanctuary for native animals and plants. Founded in 1909 and now supervised by Professor F. C. HOEHNE. — *Cf.* Ber. Deutsch. Bot. Ges. 50:154-64; Scientific Monthly 25:5-8; Chronica Botanica 1935; *Ibid.* 1936.

*Itatiaia* (Rio de Janeiro): **National Park and Biological Laboratory.**

## — *BULGARIA* —

*Varna:* **Biological Station and Aquarium:** — Situated on the Black Sea near a rocky and sandy shallow-water zone which is rich in animal and plant life and thus equipped for research and instruction in marine biology. Begun in 1906 but not opened until 1932 and now sponsored by the University of Sofia. There is a 3-story laboratory building which contains a public aquarium, research laboratories, dormitories, and a library. Courses are offered in hydrobiology and natural history for teachers. — *Station publication:* Arbeiten aus der Biologischen Meeres-station am Schwarzen Meer. — *Cf.* Int. Rev. Hydrobiol. 1:745-46; *Ibid.* 29:157-58; JUDAY 1910; KOFOID 1910.

## — *CANADA* —

*Algonquin Park* (Ontario): **Ontario Fisheries Research Laboratory:** — Sponsored by the University of Toronto for research of fisheries resources. Founded in 1919-20, the laboratory was moved to present site in 1936 and now is under the direction of Professor WILLIAM J. K. HARKNESS. Laboratory and living accommodations are available. — *Station publication:* University of Toronto Studies, Biological Series. Publications of the Ontario Fisheries Research Laboratory (1922- ).

*Kent Island* (New Brunswick): **Bowdoin Scientific Station:** — Founded in 1935 by WILLIAM A. O. GROSS of Bowdoin College (U.S.A.) to inspire research in biology and meteorology by undergraduates. Six, well-equipped buildings are available for

research from June fifteenth to September fifteenth. — *Station publications:* Contributions from the Bowdoin Scientific Station (1938- ); and annual report (mimeographed). — *Cf.* Natural History 37:195-210.

*Nanaimo* (British Columbia): **Pacific Biological Station:** — Sponsored by the Fisheries Research Board of Canada for scientific investigation of marine and freshwater problems. Dr. W. A. CLEMENS directs the large plant, which includes many well-equipped laboratories, museum, library, dormitory, kitchen, and staff offices. A 60-foot boat is available for oceanographical investigations. — *Cf.* Proceedings and Transactions of the Royal Society of Canada 3(2):lxxiii-lxxiv; Fifth Pacific Science Congress 1:200; MAGRINI 1927; Turtox 1937; VAUGHAN 1934; VAUGHAN 1937.

*St. Andrews* (New Brunswick): **Atlantic Biological Station:** — Sponsored by the Fisheries Research Board of Canada to provide facilities for research on fresh and salt-water fisheries. It is on the shore of a deep, tidal estuary of the St. Croix River. There are several laboratory buildings, experimental aquarium tanks and pools, a 90-foot diesel-engine research vessel, Zoarces, and a 28-foot vessel, Delphine. — *Cf.* Proceedings and Transactions of the Royal Society of Canada 2(4):xiii; *Ibid.* 2(5):xxi-xxii; *Ibid.* 2(6)xiii-xv; MAGRINI 1927; Turtox 1937; VAUGHAN 1937. Bot. Gaz. 27:79.

*Trois-Pistoles* (Province of Quebec): **Station Biologique du St.-Laurent:** — Located on the south shore of an estuary of the St. Lawrence River for the purpose of studying the hydrography, flora, and fauna of the region. Founded in 1931 by Laval University and now sponsored by this institution. Professor ALEXANDRE VACHON directs the work of this station which consists of a 2-story laboratory building and the 50-foot boat, Laval. — *Station publications:* Rapports annuels (1932- ); Contributions de la Station Biologique du Saint Laurent (1932- ); Fauna et Flora Laurentianae (1936- ). — *Cf.* VAUGHAN 1937.

## — *CAROLINE ISLANDS* —

*Korror Island:* **Palao Tropical Biological Station:** — Sponsored by the Japanese Society for the Promotion of Scientific Research for research in the biology of coral reefs. Professor S. HATAI is the director of the station which is housed in a one-story building. — *Station publication:* The Palao Tropical Biological Studies. — *Cf.* Nature 140:735; VAUGHAN 1937.

## — *CEYLON* —

*Colombo:* **Fisheries Research Station.**
*Peradeniya:* **Visitors' Lab. of the R. Botanic Garden.**

## — *CHILE* —

*Corral:* **Estación de Oceanografía.**

## — *CHINA* —

*Amoy* (Fukien Province): **Amoy Marine Biological Station:** — (This station has moved inland to Tingchow for the duration.) Founded in 1934 to promote the study of marine biology by the University of Amoy. Professor T. Y. CHEN is director of the station which offers a course in marine biology during the summer months. — *Station publications:* Amoy Marine Biological Bulletin; Annual Report of the Amoy Marine Biological Station (in Chinese). — *Cf.* Science 72:429-30; VAUGHAN 1934; VAUGHAN 1937.

*Sen-Kia-Men* (Chusan Islands, Chekiang); **Tinghai Marine Station:** — Founded in 1936 for biological and oceanographic research and later sponsored by the National Research Institute of Biology. — *Cf.* VAUGHAN 1934; VAUGHAN 1937.

*Tsingtao* (Shantung): **Tsingtao Marine Biological Station:** — Sponsored by the Academia Sinica and several other societies. The building was started and almost completed in July 1937, when the war started.

— *CUBA* —

*Habana:* **Institute for Marine Biology:** — The establishment of a new institute of marine biology has recently been authorized by the Dept. of Agriculture of the Govt. of Cuba. It is being located at Castillo de la Punta. The institute will include a library, a museum, a div. of "industrial experimentation", etc.

*Soledad:* **Atkins Institution of the Arnold Arboretum:** — Founded in 1898 by EDWIN F. ATKINS and now sponsored by Harvard University for tropical research in botany and zoology. Professor THOMAS BARBOUR directs the work of the station which is housed in one well-equipped laboratory building. There are separate living quarters and a 200-acre botanical garden devoted to the cultivation of economic plants. There are accommodations for six investigators at one time. — *Cf.* Science 59:433-34; Jour. of Heredity 15:451-61; Bul. Pan-American Union 70:631-38; Sci. Mon. 51:140-46; Science 94:534.

— *CZECHOSLOVAKIA** —

*Blatná:* **Station für Hydrobiologie und Fischzucht an den Lnáreteichen:** — Cf. LENZ 1927; Chronica Botanica 1936.

*Hirschberg* [*Doksy*] (Böhmen): **Station Hirschberg a. See der Reichsanstalt für Fischerei:** — Founded in 1905 by Dr. VIKTOR LANGHANS for hydrobiological research. Dr. TRUDE SCHREITER directs the work of the station which is housed in a 3-story building. — *Cf.* Verein der Naturfreunde in Reichenberg 60:46-49; KOFOID 1910; LENZ 1927.

*Krtiny* (Moravia): **Biologická Stanice Céskych Vysokychškol Brněnských:**—Sponsored by the Czechoslovakian Academy of Sciences and the Ministry of Education for research in general biology in a region of hilly lands and ponds. — *Cf.* LENZ 1927; Chronica Botanica 1935.

*Samorin* (near Bratislava): **Biologická Stanice Komenského University:** — Cf. Chronica Botanica 1936.

*Strbské Pleso* (Vysoké Tatry): **Geobotanical Station of the Czechoslovakian Botanical Society:** — Founded in 1931 and now sponsored by the Czechoslovakian Botanical Society for research in botany, ecology, and phyto-sociology. Station open to investigators from May first to November first.

*Velké Meziříči* (Mähren): **Die Franz Harrach'sche Station für Fischerei und Hydrobiologie:** — Founded in 1928 by FRANZ HARRACH and now an independent institution. There is one, well-equipped building.

— *DENMARK* —

*Charlottenlund Slot* (Copenhagen): **Dansk Biologisk Station:** — Situated on the narrow sound separating Denmark from Sweden south of the Kattegat, with a fresh-water annex at Frederiksdal. Sponsored by the Danish Ministry of Agriculture and Fisheries for investigations on marine and fresh-water problems. Dr. H. BLEGVAD directs the work of the station, which has a budget of 140,000 Kroner. Laboratory headquarters are in Charlottenlund Castle. 143-ton research steamer, Biologen, available for research problems between April first and October twentieth. — *Station publication:* Report of the Danish Biological Station (1890-91- ). — *Cf.* Revue Générale des Sciences 47:623-30; SAND 1898; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937; RICKER 1937.

*Frederikshavn:* **Universitetets Havbiologiske Laboratorium.**

*Hillerød:* **Universitetets Ferskvandsbiologiske Laboratorium:** — Situated on the shore of shallow Frederiksberg Castle Lake for the purpose of research and instruction in freshwater biology. Sponsored by the University of Copenhagen under the direction of Professor KAJ BERG. There is a 2-story, well-equipped laboratory building. A 3-week course is offered in summer to university students in fresh-water biology. — *Cf.* Int. Rev. Hydrobiol. 3:128-35; Arch. für Hydrobiol. 32(4):1-6; SCOURFIELD 1905; KOFOID 1910; JUDAY 1910; LENZ 1927; RICKER 1937.

*Noudby* (Skalling Peninsula): **Skalling-Laboratoriet:** — Sponsored by the Carlsberg Foundation for investigations of marshes, dunes, and sandflats. Two field laboratories are available to investigators, one in Noudby Harbor and another on Skalling Peninsula. — *Station publication:* Meddelelser fra Skalling-Laboratoriet (1935- ).

* Territorial boundaries as of August 1938.

— *EGYPT* —

*Alexandria:* **Fouad I Institute of Hydrobiology and Fisheries:** — Founded in 1931 and now sponsored by the Egyptian Ministry of Commerce and Industry for research on the marine and fresh-water fishes of Egypt. Dr. Hussein Faouzi is the director of a staff of five research assistants. The 3-story laboratory building contains a public aquarium, offices, library, museum, and many well-equipped laboratories. Services of the government, 42-meter Mabahiss, are available. — *Station publication:* Notes and Memoirs of the Fouad I Institute of Hydrobiology and Fisheries (1933- ). — *Cf.* Int. Rev. Hydrobiol. 30:383; Nature 141:1107; Vaughan 1937.

*Ghardaqa:* **Marine Biological Station of the Fouad I University:** — Founded in 1930 by Dr. Cyril Crossland for the Faculty of Science of the Fouad I University. On the Red Sea, at the most northernly extension of the Indo-Pacific fauna. Every variety of coral reef is to be found within easy reach of the station. There are several well-equipped laboratory and living buildings. Boats are available. The station is open throughout the year, although optimum climatic and collecting conditions are during the summer months. — *Station publications:* Announcement; Publications of the Marine Biological Station, Ghardaqa (1939- ). — *Cf.* Nature 126: 991-93; *Ibid.* 134:743-44; Chronica Botanica 1935; Vaughan 1937.

*Heliopolis* (Cairo) : **Institute of Desert Researches.**

— *EIRE* —

*Lough Ine* (Skibbereen, County Cork) : **Cork University Biological Station:** — On a tidal marine lough communicating with the sea by a very narrow-stepped channel. Founded in 1925 by Professor Louis P. W. Renouf and now sponsored by University College, Cork, for the purpose of working out the ecology of the immediate neighborhood and providing research facilities to visiting biologists. Courses offered in marine biology and ecology. — *Cf.* Journal of Ecology 19(2):410-38.

— *ENGLAND* —

*Ambleside* (Westmoreland) : **Laboratory of the Freshwater Biological Association of the British Empire:** — Founded in 1929 to promote the investigation of the biology of the animals and plants found in fresh (and brackish) waters. Sponsored by the Freshwater Biological Association of the British Empire with a budget of £4,084. Dr. E. B. Worthington is director of a staff of seven resident investigators. The station is housed in Wray Castle and is equipped with modern laboratory and living facilities. A course is offered in the principles of freshwater biology. — *Station publications:* Annual Report of the Freshwater Biological Association of the British Empire; Scientific Publication (1939- ). — *Cf.* Science 72:554; Nature 125:241-42; Science 76:248; Nature 130:140; Int. Rev. Hydrobiol. 30:247-50; Nature 142:238; Chronica Botanica 1938 and 1939.

*Blakeney Point* (Norfolk) : **Blakeney Point Research Station:** — Situated on a peninsula on the Norfolk coast, with sand dunes, salt marshes, and mud flats easily accessible. Founded in 1913 for research in the ecology and ornithology of the region. — *Station publications:* Blakeney Point Publications (1912- ); Occasional Reports of the Blakeney Point Research Station (usually appearing in the Transactions of the Norfolk and Norwich Naturalists' Society).

*Cullercoats* (Northumberland) : **Dove Marine Laboratory:** — Founded in 1897 by Prof. Alexander Meek and now sponsored by Armstrong College of the University of Durham, with A. D. Hobson as director. The 2-story laboratory building contains rooms for the classes held each Easter holiday. — *Station publication:* Dove Marine Laboratory Report. — *Cf.* Juday 1910; Kofoid 1910; Magrini 1927; Vaughan 1937.

*Plymouth:* **Plymouth Laboratory of the Marine Biological Association of the United Kingdom:** — The Devon and Cornwall shore line supports an extensive and varied fauna which is exposed by the considerable rise and fall of the tide. The station was established in 1884, opened in 1888, with additions erected in 1920, 1922, 1926, and 1939. It is sponsored by the Marine Biological Association of the United Kingdom on a budget of £16,000 annually. Dr. Stanley Kemp is director and there are twelve resident members of the staff. The plant consists of three, well-equipped laboratory buildings which contain a public aquarium, a 20,000-volume library, biological supply

sales department, classrooms, and research laboratories. The 88-foot steamer, Salpa, is equipped for trawling and plankton work and the 25-foot motorboat, Gammarus, is also available. Courses in marine biology are offered during the Easter and autumn vacations. Laboratory accommodations are available for thirty investigators in addition to the resident staff. — *Station publications:* Journal of the Marine Biological Association of the United Kingdom (1889- ); Report of the Council; Syllabus of the Course in Marine Biology; Guide to the Plymouth Aquarium. — *Cf.* The Times, London, March 31, 1884; *Ibid.* April 1, 1884; Nature 30:40, 82, 323, 350-51; Jour. Marine Biol. Assoc. 1:96-104; Nature 38:16-17; *Ibid.* 38:198-200; *Ibid.* 38:236-37; Jour. Marine Biol. Assoc. 15:734-828; New Statesman 28:105-06; Science 76:586; *Ibid.* 93:445; Dean 1894; Sand 1898; Juday 1910; Kofoid 1910; Magrini 1927; Chronica Botanica 1935; *Ibid.* 1936; Vaughan 1937.

*Port Erin* (Isle of Man) : **Marine Biological Station at Port Erin:** — On the Isle of Man in the middle of the Irish Sea and organized to provide research and instructional facilities in marine biology. Sponsored by the Department of Oceanography of the University of Liverpool with Prof. J. H. Orton as director. There is a well-equipped, 2-story laboratory building and one 20-foot motorboat. Courses are given by professors of public schools and universities who come to the station with their classes for 2-week sessions, usually during the Easter recess. — *Station publications:* Report of the Marine Biological Station at Port Erin (1888- ); Memoirs on Typical British Marine Plants and Animals of the Liverpool Marine Biological Committee (1899- ); Proceedings and Transactions of the Liverpool Biological Society (1886- ); General Regulations for Students. — *Cf.* Int. Rev. Hydrobiol. 1:740-45; Nature 82:321-22; Proc. Trans. Liverpool Biol. Soc. 34:23-74; Nature 146:58; Science 95:473; Dean 1894; Sand 1898; Juday 1910; Kofoid 1910; Magrini 1927; Chronica Botanica 1936; Vaughan 1937.

*Potterne* (Wilts.) : **Potterne Biological Station:** — *Cf.* Chronica Botanica 1:178; *Ibid.* 2:190.

*Southampton:* **Southampton Fisheries Station:** — On the River Itchen within easy access to a large variety of water conditions. Founded in 1932 as the Avon Biological Research Station by University College, Southampton, and now sponsored also by the Freshwater Biological Association of the British Empire. — *Station publication:* Annual Report of the Avon Biological Survey (1932- ). — *Cf.* Chronica Botanica 1939.

## — *ESTONIA* —

*Tartu:* **Kuusnõmme Bioloogia Jaam.**

## — *FINLAND* —

*Tvärminne:* **Station Zoologique de Tvärminne:** — Readily accessible to the station is open sea (the Gulf of Finland) and also a long, fiord-like bay. Founded in 1902 and now sponsored by the University of Helsingfors with Prof. Alexander Luther as director. There is a 2-story building which is open to independent investigators from May fifteenth to September tenth. 3-week courses are given in aquatic zoology, hydrology, and plant physiology. — *Cf.* Lenz 1927; Jahresb. Westpr. Bot.-Zool. Ver. 47:67-68.

## — *FRANCE* —

*Aix-les-Bains* (Savoie) : **Station d'Etudes Hydrobiologiques du Lac du Bourget:** — In a region of many large and small lakes, two large rivers, and easily accessible to the lakes of higher altitude in the Savoian and Dauphin Alps. Sponsored by the National School of Waters and Forests at Nancy to facilitate biological researches on the fresh-water lakes in France. The 2-story building contains a public aquarium, library, research laboratories, and living rooms. Open from April to October to qualified investigators. — *Cf.* La Nature, Paris 65(1):401-03.

*Ambleteuse* (Pas-de-Calais) : **Station Biologique de l'Université Catholique de Lille (Laboratoire Charles Maurice):** — Established in 1895 by Prof. Charles Maurice and now sponsored by the Catholic University of Lille. There is a laboratory building and also a chalet used for living accommodations. — *Cf.* Kofoid 1910; Magrini 1927.

*Arcachon* (Gironde) : **Station Biologique d'Arcachon:**—Initiated in 1863 and sponsored by La Société scientifique d'Arcachon, with Prof. H. Sigalas as director. The

two buildings contain a public aquarium, museum, well-equipped research laboratories, and living accommodations. A 31-foot motorboat is available.—*Station publications:* Bulletin de la Station Biologique d'Arcachon (1895- ); Règlement des Laboratoires. —*Cf.* DEAN 1894; SAND 1898; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Bagnères-de-Bigorre* (Hautes Pyrénées): **L'Institut et Observatoire de Physique du Globe du Pic-du-Midi:**—On the summit (9,437 feet) of a mountain in the Pyrenees. Sponsored by the University of Toulouse to aid scientists in making available to them laboratory and living facilities for research in physics and biology in high altitudes. The two weather-proof buildings contain well-equipped laboratories, library, and living quarters.

*Banyuls-sur-Mer* (Pyrénées Orientales): **Laboratoire Arago de Banyuls-sur-Mer:**—Sponsored by the Faculty of Sciences of the University of Paris for research and instruction in marine biology. Prof. E. CHATTON is director and there is a resident scientific staff of three persons. The plant contains a public aquarium, museum, library, classrooms, living accommodations, and well-equipped laboratories. A two-week course in marine biology is given usually during the Easter vacation and again in September.—*Cf.* Revue Scientifique 3(1):577-79; Arch. Zool. 1(9):563-98; Revue Scientifique 35:371-74; La Nature, Paris 14:97-99; Revue Scientifique 47:673-80; Revue des deux Mondes 120:168-86; Arch. Zool. 3(3):1-42; *Ibid.* 3(6):1-35; *Ibid.* 3(9):1-42; Cosmos 55:367-70; Revue Scientifique 70:750-53; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Besse* (Puy-de-Dôme): **La Station Biologique de Besse:**—At an altitude of 3,444 feet, in a region of more than 20 lakes of glacial and volcanic origin. Sponsored by the Faculty of Sciences of the University of Clermont for the purpose of studying the flora and fauna of the mountains, especially the limnology of the waters. The laboratory building contains living facilities and also classrooms for the two-week course given for university students in biology.—*Station publication:* Arvernia Biologica (including Annales de la Station Limnologique de Besse).—*Cf.* Revue Inter. de l'Enseignement 39:128-31; Ann. Biol. Lacustre 1:1-32; Revue générale Scientifique 37:613-14; La Nature, Paris 64(2):358-60; KOFOID 1910; LENZ 1927; Chronica Botanica 1939.

*Cévennes:* **Laboratoire de Montagne de l'Aigoual (Université de Montpellier):**—According to Dr. and Mrs. VERDOORN, who visited this in 1932, without laboratory facilities.

*Concarneau* (Finistère, Brittany): **Laboratoire de Zoologie et de Physiologie Maritimes du Collège de France:**—Founded in 1859 by Prof. COSTE and now sponsored by the College of France at Paris. The purpose of the institution is to facilitate research in pure and applied marine biology. The 2-story building is well-equipped and the scientific work is under the direction of Dr. R. LEGENDRE.—*Cf.* Nature 29:16-17; Ann. Soc. Belg. Micro. 28:1-44; Revue Scientifique 70:750-53; DEAN 1894; SAND 1898; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Dinard* (Ille et Vilaine): **Laboratoire Maritime du Museum National d'Histoire Naturelle:**—At the mouth of the River Rance, with pronounced tides. Founded in 1882 and now sponsored by the National Museum of Natural History of Paris for research in oceanography and marine biology. The two buildings contain a public aquarium, marine museum, library, and research laboratories. The station is open from June to September.—*Station publication:* Bulletin du Laboratoire Maritime de Dinard (1928- ).—*Cf.* La Nature, Paris 16(2):186-88; Ann. Scient. Nat. Zool. 7(1):1-46; SAND 1898; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Endoume:* **Laboratoire Marion de Marseille:**—Sponsored by the Faculty of Science of the University of Marseilles for instruction and research in marine zoology. The 3-story building contains a public aquarium, marine museum, classroom, and research laboratories.—*Station publication:* Travaux du Laboratoire de Zoologie et du Laboratoire Marion.—*Cf.* Ann. Musée d'Hist. Nat. Marseille 3:7-18; DEAN 1894; SAND 1898; KOFOID 1910; VAUGHAN 1937.

*Le Croisic* (Loire Inférieure): **Laboratoire de Biologie Maritime de Le Croisic:**—Accessible to sandy shores, salt marshes, and sand dunes. Founded in 1920 by Prof. ALPHONSE LABBÉ and now sponsored by the School of the Practice of Medicine and Pharmacy at Nantes. Station open to a maximum of eight investigators from July to September.—*Cf.* MAGRINI 1927; VAUGHAN 1937.

*Le Lautaret* (Hautes Alpes): **Institut de Botanique Alpine Marcel Mirande:**—

On a mountain pass in the western Alps at an elevation of 6,888 feet, the region containing about 2,000 species of plants. Founded in 1899 by Prof. LACHMANN and now sponsored by the University of Grenoble for the purpose of culturing alpine plants of different regions of the world and of studying their biology and propagation. There is a large alpine garden, a museum, library, and research rooms. The station is open from July first to September first. — *Cf.* Université de Grenoble Annales 32:1-31; La Nature, Paris 54(2):257-60.

*Luc-sur-Mer* (Calvados): **Laboratoire de Luc-sur-Mer de la Faculté des Sciences de Caen:** —Founded in 1874, the building now contains research laboratories, library, and marine aquarium. — *Cf.* SAND 1898; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Montpellier* (Hér.): **Station Internationale de Géobotanique Méditerranéenne et Alpine:** — Founded in 1930 by an international committee of botanists and now directed by Prof. J. BRAUN-BLANQUET for the study of geobotany and the methods of phytosociology and ecology. The building contains well-equipped laboratories, herbarium, and library. The station is open from September to July, with facilities for work especially in the Alps during the summer months. — *Station publications:* Communications de la Station Internationale de Géobotanique Méditerranéenne et Alpine, Montpellier (1930- ); Prospectus; Prodrome des Groupements Végétaux (1931- ). — *Cf.* Rev. Bot. Appl. d'Agr. Col. 10:1-4; Chronica Botanica 1935; *Ibid.* 1936; *Ibid.* 1938 (on the new building).

*Orédon* (Hautes-Pyrénées): **Laboratoire Biologique du Lac d'Orédon:** — On the shore of a mountain lake at an altitude of 6,071 feet. Sponsored by the University of Toulouse to help scientific workers study mountain biology. The 2-story building contains laboratory and living accommodations. Open to investigators from July fourteenth to August thirteenth.

*Roscoff* (Finistère): **Station Biologique de Roscoff (Laboratoire Lacaze-Duthiers):** — Dedicated to research and instruction in marine biology and sponsored by the Faculty of Sciences of the University of Paris with an annual budget of 150,000 francs. Prof. CHARLES PÉREZ directs the work of the station, which consists of five buildings. These contain a herbarium, classroom, library, darkrooms, and well-equipped general and special laboratories. A 17-passenger bus and an 18-ton vessel, Dundee, are also attached to the station. Two courses are offered in marine biology. — *Station publications:* Travaux de la Station Biologique de Roscoff (1923- ); Conditions d'Admission. — *Cf.* Arch. Zool. 1(3):1-38; *Ibid.* 1(6):311-62; *Ibid.* 1(9):543-62; Nature 29:16-17; Arch. Zool. 2(9):255-363; *Ibid.* 3(3):1-42; *Ibid.* 3(6):1-35; Ann. Soc. Belge Micr. 28:1-44; Science 28:479-80; Int. Rev. Hydrobiol. 1:282-88; *Ibid.* 2:493-97; L'Illustration 86(1):393-95; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937; Bull. Soc. R. Bot. Belg. 46:224-249 (especially on phycological facilities).

*Sète* (Hérault): **Station Biologique de Sète:** — Founded in 1879 and now sponsored by the Institute of Zoology and General Biology of the University of Montpellier. The large, 2-story building contains a public aquarium, museum, classroom, library, living rooms, and several laboratories. — *Station publication:* Travaux de la Station de Sète. — *Cf.* DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Tamaris-sur-Mer:* **Station Maritime de Biologie de Tamaris:** — Sponsored by the Faculty of Sciences of the University of Lyon in order to study the flora and fauna of the region of Toulon. The large, Mooresque laboratory building is open to investigators from March fifteenth to May first and from June twentieth to October twentieth. — *Cf.* Bull. Soc. Amis de l'Univ. Lyon 11:244-56; SAND 1898; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Villefranche-sur-Mer* (Alpes Maritimes): **Station Zoologique de l'Université de Paris à Villefranche-sur-Mer:** — On the shores of the Mediterranean Sea with an exceptional pelagic fauna, both in abundance and variety. Sponsored by the University of Paris to aid in research on different problems of marine biology. There is a well-equipped building for laboratory work and living accommodations. A 4-ton motorboat is available. Vacation course in marine biology offered during Easter recess. — *Station publication:* Travaux de la Station Zoologique de Villefranche-sur-Mer (1925- ). — *Cf.* Arch. Sci. Phys. et Nat. 12:1-11; Ann. Soc. Belge Micr. 28:1-44; Int. Rev. Hydrobiol. 10:317-19; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Wimereux* (Pas-de-Calais) : **Station Zoologique de Wimereux:** — On the shore of the Straits of Dover and dedicated to research and instruction in zoology and botany. Established in 1874 by Prof. ALFRED GIARD and now sponsored by the Faculty of Sciences of the University of Paris with Prof. MAURICE CAULLERY as director. The laboratory buildings are open to investigators from April to October inclusive. — *Station publications:* Bulletin Biologique de la France et de la Belgique; Travaux de la Station Biologique de Wimereux (1879- ). — *Cf.* Revue Scientifique 4:217-22; Revue de l'Enseignement des Sciences 1:329-38; Revue du Mois 6:385-99; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

## — *FRENCH INDO-CHINA* —

*Cauda* (Nhatrang, Annam) : **Institut Océanographique de l'Indochine:**—In a region with rocky and sandy shores and coral reefs. Founded in 1922 and now sponsored by the Government-General of Indo-China for scientific researches in physical and biological oceanography and the establishment of a museum and aquarium. There is a well-equipped, 2-story building and the 147-foot research vessel, De Lanessan. — *Station publications:* Notes; Mémoires; Annual Report. — *Cf.* La Nature, Paris 65(1):452-53; MAGRINI 1927; VAUGHAN 1934; VAUGHAN 1937.

## — *GERMANY** —

*Bellinchen a. Oder:* **Biologische Station Bellinchen:** — Located on the Oder River for the purpose of instruction and research in ecology and related subjects. Courses are given in faunistics, floristics, and ecology.

*Dümmersee* (near Osnabrück) : **Forschungshütte des Landesmuseum Hannover:**— *Cf.* Chronica Botanica 1938.

*Garmisch-Partenkirchen* (Bayern) : **Alpenlaboratorium auf dem Schachen bei Garmisch:** — At an altitude of 6,232 feet, this institution is sponsored by the Bavarian Ministry for Instruction and Culture and the Union for the Protection of Alpine Plants for the culture and study of alpine plants. Dr. F. C. v. FABER directs the work of the station, which is open to research workers from June fifteenth to October first.

*Hallstatt:* **Botanische Station in Hallstatt:** — A private laboratory sponsored by Dr. FRIEDRICH MORTON for investigating the natural history of Hallstatt and vicinity. Investigators may make use of the station's facilities. — *Cf.* Chronica Botanica 1:84; *Ibid.* 2:76; *Ibid.* 5:256.

*Helgoland:* **Biologische Anstalt auf Helgoland:** — An independent institution under the direction of Prof. A. HAGMEIER. The large, 6-story building contains workshops, darkrooms, culture rooms, offices, library, public aquarium, herbarium, class laboratories, and many research laboratories. The 112-foot research vessel, Makrele, is attached to the station. Four courses are given in marine biology. — *Station publications:* Helgoländer Wissenschaftliche Meeresuntersuchungen (1937- ); Ordnung für Vergebung und Benutzung der Arbeitsplätze; Lehrveranstaltungen der Biologischen Anstalt.—*Cf.* Zool. Anz. 15:290-92; *Ibid.* 16:124-27; Bot. Centralblatt 54:139-42; Rept. Smithsonian Inst. for 1893:505-19; Wiss. Meeresuntersuch., Abth. Helgoland 1:1-36; Verh. Deutsch. Zool. Ges. 6:177-82; Verh. Zool.-Bot. Ges., Wien 47:47-54; Mitth. deutsch. Seefischerei-Ver. 15:107-19; Zeitschr. d. Ver. Deutsch. Ingen. 47:807-12; Zeitschr. f. Bauverwaltung 25:470-72; Naturwissenschaften 6:569-72; Der Fischerbote 11:184-88; Int. Rev. Hydrobiol. 10:727-39; Cons. Intern. Expl. Mer, Rapports et Procès-Verbaux des Réunions 47(3):17-33; Der Biologe 7(3):161-83; Westermanns Monatshefte 157:513-20; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Helgoland:* **Vogelwarte Helgoland:** — Situated on the only island in a large area of the North Sea and consequently a frequent stopping place for migrating birds. Founded in 1909 for investigating the migration and protection of birds and for instruction in ornithology. The 2-story building contains bird collections, offices, library, classroom, and laboratories. There are bird-traps for banding in the adjacent gardens. A course is offered in ornithology. — *Cf.* Der V. Internat. Ornithol. Kongress 1910:564-75; Brit. Birds 27:284-89; Der Biologe 3(7):184-86; Vogelzug 7:35-50.

* Territorial boundaries as of March 1938 (*i.e.*, including Austria).

*Husum* (Schleswig-Holstein): **Zoologische Station.**

*Kiel:* **Institut für Meereskunde der Universität Kiel:** — Sponsored by the University of Kiel with Prof. A. REMANE as director. The 3-story building contains a number of well-equipped laboratories. — *Station publication:* Kieler Meeresforschungen (1936-37- ). — *Cf.* Kieler Meeresforschungen 3:1-16; K. BRANDT, *Die* beiden Meereslaboratorien in Kiel (Conseil Perm. Int. pour l'Explor. de la Mer, 1926, pp. 16).

*Kloster Hiddensee* (Pommern): **Biologische Forschungsanstalt Hiddensee:** — Sponsored by the University of Greifswald and the Province of Pommern for instruction and research in the plant ecology and biology of the region. There is complete laboratory equipment, including an ornithological station. Vacation courses in ornithology, hydrobiology, and ecology are offered. — *Station publication:* Hydrobiologischer und Ökologischer Ferienkursus auf Hiddensee. — *Cf.* Chronica Botanica 1:145-46.

*Krefeld:* **Limnologische Station der Kaiser Wilhelm-Gesellschaft:** — Sponsored by the Kaiser Wilhelm-Gesellschaft and the City of Krefeld for the limnological examination of the lower Rhine waters. — *Station publication:* Natur am Niederrhein. — *Cf.* Zool. Anz. 80:336; Int. Rev. Hydrobiol. 22:128; Der Naturforscher 6(3):1-8; Chronica Botanica 1936; *Ibid.* 1938.

*Langenargen:* **Institut für Seenforschung und Seenbewirtschaftung der Kaiser Wilhelm-Gesellschaft:** — Located on the shore of Bodensee and sponsored by the Kaiser Wilhelm Institute for the purpose of freshwater investigation and instruction. Dr. HANS-JOACHIM ELSTER is director of the Institute, which is housed in a 3-story building. A 3-week course in limnology is offered each July. — *Cf.* Rivista di Biologia 2:550-52; Int. Rev. Hydrobiol. 9:235-36; *Ibid.* 15:258-63; Der Biologe 4:134-37; Arch. Hydrobiol. 33:164; Int. Rev. Hydrobiol. 38:512; LENZ 1927; RICKER 1937.

*Lunz-am-See:* **Biologische Station Lunz** (Kupelwiesersche Stiftung): — On the shores of Lunz Lake, a typical sub-alpine lake at an elevation of about 2,000 feet. Sponsored by the Academy of Sciences of Vienna and the Kaiser Wilhelm Institute for instruction and research in fresh-water and alpine ecology. Founded in 1906 by Dr. KARL KUPELWIESER and now directed by Dr. F. RUTTNER. The 2-story building contains work-shops, greenhouses, darkrooms, offices, library, and many laboratories. A 3-week course in hydrobiology is given each summer. — *Cf.* Die Umschau 10:944-47; Biol. Zbl. 26:463-80; Arch. Hydrobiol. 2:465-99; Int. Rev. Hydrobiol. 1:297-99; *Ibid.* 13:213; *Ibid.* 29:148-54; Naturwissenschaften 2:313-21; KOFOID 1910; JUDAY 1910; LENZ 1927; RICKER 1937; Abderhalden's Handb. 9, 2.

*Plön* (Holstein): **Hydrobiologische Anstalt der Kaiser Wilhelm-Gesellschaft:** — Located in a morainal lake district and dedicated to research in hydrobiology and limnology. Founded in 1892 by Dr. OTTO ZACHARIAS and now sponsored by the Kaiser Wilhelm Institute with Dr. A. THIENEMANN as director and Dr. FR. LENZ as director of scientific work. There is a well-equipped, 3-story building and a 32-foot motorboat. — *Cf.* Zool. Anz. 3(11):18-27; *Ibid.* 3(12):600-04, 655-56; Verh. Ges. dtsch. Naturf. Ärzte 63(11):120-21; Rev. biol. du Nord France 4:146-49; Zool. Anz. 15:36-39; Int. Rev. Hydrobiol. 1:507-09; SAND 1898; SCOURFIELD 1905; JUDAY 1910; KOFOID 1910; LENZ 1927; RICKER 1937.

*Rossitten* (Kurische Nehrung, Ostpreussen): **Vogelwarte Rossitten der Kaiser Wilhelm-Gesellschaft:** — On a great "migratory bridge" for birds near the Baltic Sea. Founded in 1901 and now sponsored by the Kaiser Wilhelm-Gesellschaft for research and instruction in ornithology. Dr. ERNEST SCHÜZ directs the work of the station, which is housed in four buildings and three field annexes. An elementary course in ornithology is offered early in October. — *Station publications:* Der Vogelzug; Lehrgang der Vogelwarte Rossitten. — *Cf.* Der Biologe 4:225-27; Vogelzug 9(2):70-90.

*Saarbrücken:* **Hydrobiologische Station:** — *Cf.* Int. Rev. Hydrobiol. 10:549-50; Rivista di Biologia 4:401-02.

*Seeon* (Chiemgau, Oberbayern): **Biologisches Laboratorium Seeon:** — A private laboratory sponsored by Prof. R. WOLTERECK for faunistic studies on differentiation of animal races in lakes and related habitats. Open to foreign investigators from April first to November first. — *Cf.* Int. Rev. Hydrobiol. 20:213-15.

*Wasserburg* (Bavaria): **Biologische Station Wasserburg am Bodensee:** — Sponsored by the Kaiser Wilhelm Institute (for some time directed by Dr. HELMUT GAMS) for researches in limnology and related subjects. — *Cf.* Int. Rev. Hydrobiol. 15:144; LENZ 1927.

— *GREENLAND* —

*Godhavn* (Disko Island): **Den Danske Arktiske Station:** — Well within the Arctic Circle (latitude: 69° 14′ N.) and near diversified arctic habitats. Founded in 1906 by MORTON P. PORSILD and now sponsored by the Government of Denmark for research in arctic science. The buildings contain good laboratory and living accommodations, a herbarium, and a library. Motorboats are available, as are sledges and camping equipment. The station is open throughout the year, being primarily a laboratory and not a base for travel. — *Station publication:* Arbejder fra den Danske Arktiske Station. — *Cf.* American Naturalist 39:505-06; Nature 108:320-21; Current History 16:637-41.

— *HAWAII* —

*Honolulu:* **Marine Biological Laboratory of the University of Hawaii:** — On the shore of Waikiki reef, a habitat rich in animal and plant forms. Established in 1920 and now sponsored by the University of Hawaii for instruction and research in marine biology. Prof. C. H. EDMONDSON directs the work of the station, the facilities of which are open to investigators between June and September. — *Cf.* Jour. Pan-Pacific Research Institute 6(2):6-9; MAGRINI 1927; Turtox 1937; VAUGHAN 1934; VAUGHAN 1937.

— *HUNGARY* —

*Tihany:* **Hungarian Biological Research Institute:** — On the shore of Lake Balaton, the largest lake in Central Europe. Established for biological investigations of the organisms living in the lake and general biological researches independent of local questions and sponsored by the Hungarian Ministry of Education. The station has an annual budget of 35,000 pengö. There are ten resident investigators, with Prof. GEZA ENTZ as director. The 4-story laboratory building is unusually well-equipped. Extension courses are given for middle-school teachers in biology. — *Station publications:* A Magyar Biologiai Kutatointezet Munkai (Arbeiten des Ungarischen Biologischen Forschungs Institutes) (1927- ); Prospectus (in English). — *Cf.* Ann. Biol. Lacustre 14:205-07; Arch. Balaton. 1:1-14; Nature 120: 968-69; Int. Rev. Hydrobiol. 13:370-72; *Ibid.* 18:435-36; Bull. Mus. Hist. Nat., Paris 33:468-69; Nature 121:93; LENZ 1927; Chronica Botanica 1935; *Ibid.* 1936.

— *INDIA* —

*Calicut* (South Malabar): **West Hill Marine Biological Station:** — On a narrow belt of low land lying between the sea and the lofty Western Ghat Mountains. Sponsored by the Madras Department of Fisheries for marine fishery research in general. — *Cf.* VAUGHAN 1937.

*Ennur* (Madras): **Ennur Biological Station:** — Sponsored by the Madras Department of Fisheries to supply biological specimens, although investigators may make use of the station's facilities. — *Cf.* VAUGHAN 1937.

*Pamban* (Krusadai Island, Madras): **Krusadai Marine Biological Station:** — The surrounding flora and fauna are among the richest in south India. Established in 1930 by the Madras Department of Fisheries for marine fishery research. The station is fairly well-equipped and there is the motor launch, The Pearl. — *Cf.* VAUGHAN 1937.

— *ITALY* —

*Cagliari* (Sardinia): **Stazione Biologica:** — *Cf.* Int. Rev. Hydrobiol. 12:434-35; KOFOID 1910; JUDAY 1910.

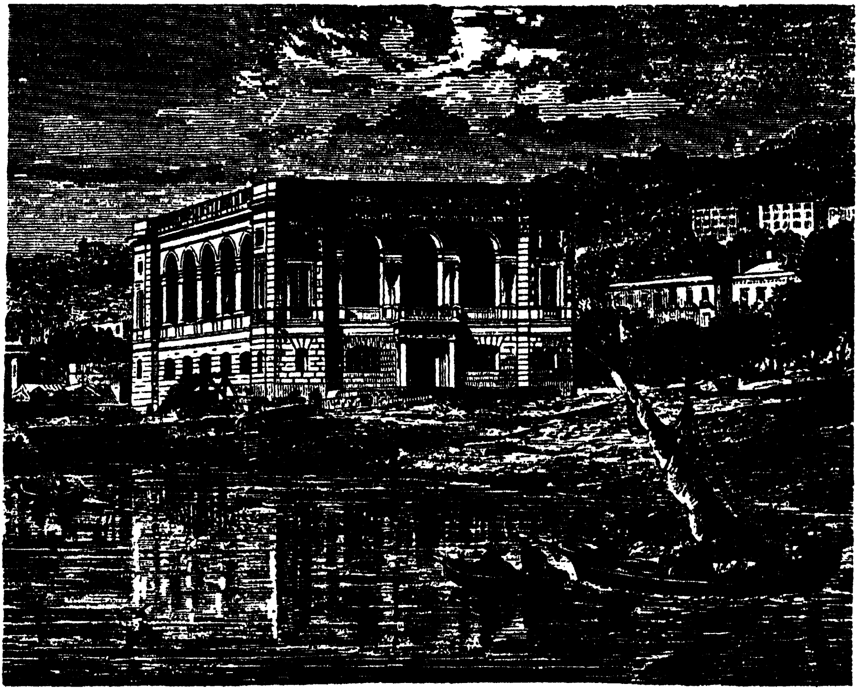
*Col d'Olen* (Alagna Sesia, Vercelli): **Istituto Scientifico Angelo Mosso sul Monte Rosa:** — In the Pennine Alps, at an altitude of 9,520 feet, with the cabin at Point Gnifetti at an altitude of 14,944 feet. Sponsored by the Royal University of Turin for scientific research in the mountains. The 3-story building contains laboratory and living accommodations. The institute is open during July and August. — *Station publication:* Atti del Laboratorio Angelo Mosso.

*Messina* (Sicily): **Istituto Centrale di Biologia Marina di Messina:** — Sponsored by the Royal Italian Oceanographical Committee for research in marine biology. — *Sta-*

*tion publications:* Memorie Istituto Centrale di Biologia Marina di Messina; Bolletino Istituto Centrale di Biologia Marina di Messina. — *Cf.* Revue Scientifique 55:381-86; MAGRINI 1927; VAUGHAN 1937.

*Monte del Lago* (Umbria): **R. Stazione Idrobiologica del Lago Trasimeno:** — Founded in 1922 by Prof. OSVALDO POLIMANTI and now sponsored by the Italian Ministry of Agriculture and Forestry to investigate the flora and fauna of the region. There is a 2-story laboratory building and a 25-foot motorboat. — *Cf.* Int. Rev. Hydrobiol. 9:546-50; *Ibid.* 11:565; Rivista di Biologia 6:566-74; Věda Přirodni 8:44-47; LENZ 1927; Chronica Botanica 1936.

*Naples:* **Stazione Zoologica di Napoli:** — On the Bay of Naples and dedicated to any kind of biological research by qualified investigators from any nation. Founded



DOHRN'S INTERNATIONAL ZOOLOGICAL STATION AT NAPLES, A SHORT TIME AFTER THE COMPLETION OF THE ORIGINAL BUILDING (*contemporary woodcut*).

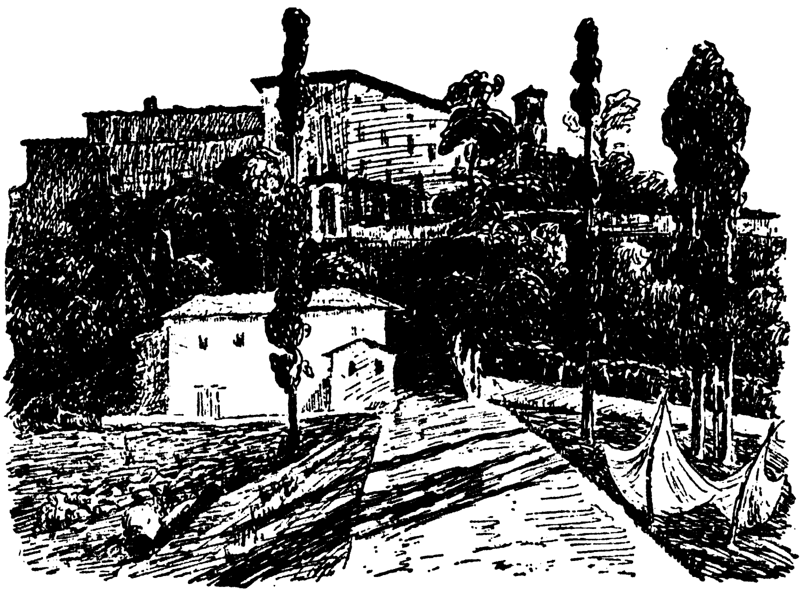
in 1870 by ANTON DOHRN, opened in 1874, with additions to building made in 1888 and 1903. Conducted as an autonomous institution with an annual budget of about 900,000 lire. Prof. REINHARD DOHRN heads the resident staff of five investigators. The 4-story building contains a public aquarium, supply department, public museum, darkrooms, workshops, offices, library, herbarium, kitchen, and various kinds of well-equipped laboratories. The station can accommodate 65 investigators at one time. — *Station publications:* Pubblicazioni della Stazione Zoologica (continuing Mitteilungen aus der Zoologischen Station zu Neapel) (1916- ); Fauna e Flora del Golfo di Napoli (1880- ); Regulations for Prospective Investigators; Prezzi di vendita degli animali marini conservati; Guide to the Aquarium of the Zoological Station at Naples. — *Cf.* especially bibliography in KOFOID 1910; Nature 5:277-80, 437-40; *Ibid.* 6:362-63, 535-36; *Ibid.* 8:81; Science n.s. 1:479-81, 507-10; *Ibid.* 2:93-97; Nature 43:392-93; *Ibid.* 48:440-43; Science 1:238-39; *Ibid.* 3:16-18; American Naturalist 31:960-65; Science 5:832-34; Bot. Gaz. 23:278-82; Popular Science Monthly 59:419-29; Science 16:993-94; Die Umschau 2:116-18; Science 25:355-56; *Ibid.* 36:453-68; Popu-

lar Science Monthly 77:209-25; Science 52:323-25; Int. Rev. Hydrobiol. 10:739-40; Rivista di Biologia 5:788; Science 59:361; *Ibid.* 59:182-83; Rivista di Biologia 6:255-61; Int. Rev. Hydrobiol. 12:266-67; Science 61:585-86; *Ibid.* 63:271; Naturwissenschaften 14:412-24; Science 65:289-90; *Ibid.* 90:206; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Pallanza:* **Istituto Italiano di Idrobiologia Dott. Marco de Marchi:** — Supervised by the Ministry of National Education for research in limnology. — *Cf.* Rivista di Biologia 25:438.

*Piccolo San Bernardo* (Aosta): **Giardino Alpino "La Chanousia" e Lab. di Botanica Alpina "De Marchi":** — *Cf.* Chronica Botanica 1:200; *Ibid.* 1:219.

*Rovigno d'Istria:* **Istituto Italo-Germanico di Biologia Marina di Rovigno d'Istria:** — Established in 1870 at Trieste by Dr. O. HERMES and moved to present site in 1891. Now sponsored by the Royal Italian Oceanographic Committee and the Kaiser



A VIEW OF THE HYDROBIOLOGICAL STATION AT THE LAGO TRASIMENO, UMBRIA, ITALY, SEEN FROM THE LANDING (*drawing by V. Bauer*).

Wilhelm Institute for instruction and research in marine biology, especially of the Adriatic Sea. The 4-story building contains a public aquarium, scientific sales department, museum, herbarium, offices, and research laboratories. — *Station publications:* Note (or Notizen) (1932- ); Thalassia (1938- ); Announcement; Liste der abgebbaren Seetiere und-pflanzen für wissenschaftliche Institute und den biologischen Unterricht. — *Cf.* Zool. Anz. 16:356-71; *Ibid.* 16:401-04; Int. Rev. Hydrobiol. 1:297; *Ibid.* 3:258-61; Die Naturwissenschaften 22:1-8; Rivista di Biologia 2:546-49; Int. Rev. Hydrobiol. 10:551; *Ibid.* 10:739-40; Science 58:9; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*San Guiliano:* **Laboratorio di Biologia Marina per il Mare Ligure:** — On the rocky beach of the Ligurian Sea. An autonomous institution owned by Professors ALESSANDRO BRIAN and RENATO SANTUCCI to aid in the study of marine biology. — *Cf.* Int. Rev. Hydrobiol. 5:179-80; Arch. Zool. Ital. 23(9-10); Rivista di Biologia 22:535-48; MAGRINI 1927; VAUGHAN 1937.

*Taranto:* **Istituto Demaniale di Biologia Marina di Taranto:** — Sponsored by the National Research Council of the Ministry of National Education for research in general marine biology. Prof. ATTILIO CERRUTI directs the work of the station, which is

housed in a 3-story, well-equipped building. The 33-foot vessel, Galeso, is available as are two motorboats and two sailboats. — *Cf.* Rivista di Biologia 3:379-90; Int. Rev. Hydrobiol. 10:196; *Ibid.* 29:294-95; Rivista di Biologia 15:386-90; MAGRINI 1927; VAUGHAN 1937.

## — *JAMAICA* —

*Cinchona:* **Botanical Gardens:** — At various times these gardens have been used as an American biological station. *Cf.* VERDOORN, 1945, "Plants and Plant Science in Latin America", p. xxi: "Many botanists of today do not know of the early efforts to found an American Tropical Laboratory (*cf.* Bot. Gaz. 22:415 and 494, 1896, etc.), culminating in the establishment of a tropical biological station (in 1903) at Cinchona, Jamaica (*cf.* MAXON 1922, Smiths. Rept. for 1920, p. 529, etc.). — Still much less is known today of the grandiose plans of LUIGI BUSCAGLIONI, who planned a second 'hortus bogoriensis' on the Amazon (ca. 1900), traveling widely to obtain sympathy and support (for a pathetic account of his efforts *cf.* Nuovo Giorn. Bot. Ital. 9:1-32, 1902). — A plan to establish a British tropical research station at Jamaica has recently been developed by V. J. CHAPMAN (Nature 152:47, 1943)".

## — *JAPAN* —

*Akkeshi:* **Akkeshi Marine Biological Station:** — On the sea front of the Gulf of Akkeshi with sandy beaches, rocky beaches, and a muddy bottom. Established in 1931 and sponsored by the Hokkaido Imperial University for research and instruction in biology. There is a 3-story building and a 26-foot motorboat, Misago. Course work is given in marine biology, marine invertebrate zoology, marine algae, experimental morphology, and physiology. — *Station publications:* Contributions from the Akkeshi Marine Biological Station; The Akkeshi Marine Biological Station (a guide printed in Japanese). — *Cf.* VAUGHAN 1937.

*Asamushi* (Aomori-ken): **Marine Biological Station of the Tohoku Imperial University:** — On the shore of Mutsu Bay, facing a shallow sea of about four fathoms in depth. Sponsored by the Faculty of Science of Tohoku Imperial University for research and instruction in marine biology. Founded in 1924 by Prof. SINKISHI HATAI and now directed by Prof. SANJI HOZAWA. The station contains a public aquarium, dormitories, library, classrooms, and well-equipped research laboratories. Three-week courses are given in marine biology, systematic botany, planktology, algology, comparative physiology, and seismology. — *Cf.* Records of the Oceanographic Works in Japan 1:26-38; VAUGHAN 1934; VAUGHAN 1937.

*Fukushima* (Kiso, Nagano Prefecture): **Kiso Biological Station:** — In a forested, mountainous region with torrential streams. Sponsored by Kyoto Imperial University to extend limnological researches to the life in streams and torrents.

*Hunami-cho* (Muroran, Hokkaido): **Institute of Algological Research:** —Founded in 1933 and now sponsored by Hokkaido Imperial University for research work on marine algae. Prof. Y. TAMADA directs the work of the institute which maintains laboratory and living accommodations. — *Station publication:* Reports from the Marine Station for Algological Research (in Japanese). — *Cf.* Chronica Botanica 1935; *Ibid.* 1936; VAUGHAN 1937.

*Kannonji* (Otsu, Shiga-ken): **Otsu Hydrobiological Station:** — On Biwa Lake, the largest in Japan, with a central basin about 100 meters in depth and surrounded by various types of shores. Founded in 1914 and now sponsored by the College of Science of Kyoto Imperial University for research and instruction in limnology and allied subjects. The 2-story building contains library, aquarium, offices, and laboratories. Courses given in physiology and freshwater biology. — *Station publication:* Contributions from the Otsu Hydrobiological Station. — *Cf.* Int. Rev. Hydrobiol. 28:350; LENZ 1927.

*Kominato Bay* (Chiba Prefecture): **Kominato Marine Biological Laboratory:** — On the rocky shores of Kominato Bay, the depth being 100 kilometers within four kilometers from shore. Sponsored by the Imperial Fisheries Institute for research and instruction in marine biology. — *Cf.* VAUGHAN 1937.

*Misaki* (Kanagawa Prefecture): **Misaki Marine Biological Station:** — Founded in 1885 by the College of Sciences of the Imperial University of Japan and now spon-

sored by the Imperial University of Tokyo for research and instruction in marine biology, oceanography, and allied sciences. The plant contains dormitories, aquarium, museum, seismographic apparatus, and many laboratories. Summer courses given in marine zoology. — *Station publication:* Journal of Faculty of Science, Section IV, Tokyo Imperial University. — *Cf.* Pop. Sci. Mon. 1904:195-204; SAND 1898; VAUGHAN 1934; VAUGHAN 1937.

*Osshoro* (Hokkaido): **Osshoro Marine Biological Station:** — *Cf.* VAUGHAN 1934.

*Seto-Kanayama* (Wakayama-ken): **Seto Marine Biological Laboratory:** — Established in 1922 by Prof. IWAJI IKEDA of Kyoto Imperial University for research work in marine biology and for the instruction of students at Kyoto Imperial University. The Laboratory is well-equipped and includes the use of the 19-ton collecting vessel, Nyusin Maru. Courses are given in anatomy, experimental zoology, algology, and elementary oceanography. — *Cf.* Records of Oceanographic Work in Japan 1(3):113-29; VAUGHAN 1934; VAUGHAN 1937.

*Shimoda-machi* (Shizuoka-ken): **Shimoda Marine Biological Station:** — Sponsored by the Tokyo University of Literature and Science for research and instruction. There is one laboratory building and several boats. Course work is given in zoology, botany, oceanography, and science education. — *Cf.* VAUGHAN 1937.

*Susaki* (Kamogun, Siduoka Prefecture): **Mitsui Institute of Marine Biology:** — Adjacent tide pools and rocky strands abound in a rich fauna and flora. Established in 1933 by Mr. TAKANAGA MITSUI for the study of marine biology and to afford facilities for the research workers at the station. It is an autonomous institution with an annual budget of 25,000 yen. The 2-story building contains an aquarium, museum, library, and well-equipped laboratories. Fellowships are awarded annually by the station to research workers who desire to investigate marine material at the station.— *Cf.* VAUGHAN 1937.

*Tomioka* (Amakusa, Kumamoto Ken): **Amakusa Marine Biological Laboratory:** — Sponsored by Kyushu Imperial University. — *Cf.* Records of the Oceanographic Works in Japan 1(2):78-89; VAUGHAN 1934; VAUGHAN 1937.

## — *LATVIA* —

*Riga:* **Hydrobiologische Station der Lettländischen Universität:** — Founded in 1924 and now sponsored by the University of Latvia for research and instruction in hydrobiology. Prof. EMBRIK STRAND directs the work of the station, which is housed in one of the university buildings in Riga. There is a field annex at Kurland on Lake Usmaitenschen. — *Station publication:* Folia Zoologica et Hydrobiologica. — *Cf.* Int. Rev. Hydrobiol. 12:435; *Ibid.* 21:478-80; LENZ 1927; VAUGHAN 1937.

## — *MANCHUKUO* —

*Harbin:* **Sungari River Biological Station:** — *Cf.* LENZ 1927.

## — *MARTINIQUE* —

*Fort de France:* **Museum et Laboratoire Océanographique de M. Conseil:** — *Cf.* MAGRINI 1927.

## — *MEXICO* —

*Pátzcuaro* (Michoacán): **Estación Limnológica:** — On Lake Pátzcuaro at an altitude of over 6,000 feet. Sponsored by the Division of Fisheries of the Department of Marine of the Mexican Government to investigate the facilities of the lake as a center of fishing and to make a general survey of the lake. Mr. MANUEL ZOZAYA is director and Dr. FERNANDO DE BUEN is scientific advisor. There are ample laboratory and living facilities. — *Cf.* The Collecting Net 15:202.

## — *MONACO* —

*Monaco-ville:* **Musée Océanographique et Aquarium de Monaco:** — On the Mediterranean Sea, with the shore sloping abruptly to deep water, often 300 to 500 meters in depth within three miles from shore. Founded in 1899 by ALBERT I, Prince of

Monaco, for original research in marine subjects and public education in oceanography. It is an autonomous institution, being a part of the Institute of Oceanography at Paris. Dr. JULES RICHARD is director of the institution, which has an annual budget of 1,300,-000 francs. The large, 4-story building contains a large public museum of oceanography, public aquarium, library, offices, darkrooms, and well-equipped laboratories. The 25-ton, 54-foot steamer, Eider, is available for collecting. The station is open from October first to July twenty-fifth. — *Station publications:* Bulletin de l'Institut Océanographique (1904- ); Les Résultats des Campagnes Scientifiques de S.A.S. Prince Albert Ier de Monaco (1889- ); Règlement Général Concernant l'Admission des Travailleurs faisant des Recherches; Musée Océanographique et Aquarium de Monaco (Guide Illustré). — *Cf.* Int. Rev. Hydrobiol. 1:504-07; Science 63:468-69; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

## — *MOROCCO* —

*Rabat:* **Institut Scientifique Chérifien:** — Sponsored by the Direction of Public Education of Morocco for scientific research in French Morocco. Dr. J. DE LÉPINEY directs the work of the station, which has an annual budget of 650,000 francs. — *Cf.* Chronica Botanica 1936.

## — *THE NETHERLANDS* —

*Abcoude:* **Laboratory of the Hugo de Vries Foundation:** — *Cf.* LENZ 1927; Chronica Botanica 1935; *Ibid.* 1936.

*den Helder:* **Zoölogisch Station der Nederlandsche Dierkundige Vereeniging:** — At the mouth of the Zuiderzee, close to the large sandflat area of northern Holland. Founded in 1876 and now sponsored by the Netherlands Zoological Society and the Netherlands Ministry of Education, Arts, and Sciences for marine biological investigations in the widest sense of the term. Dr. J. VERWEY directs the work of the station, which has an annual budget of 12,700 guilders. The 2-story building contains a public aquarium, library, office, classroom, and well-equipped laboratories. There is also a building with living accommodations. The 43-foot vessel, Max Weber, is available for collecting. — *Cf.* Arch. Zool. 1(6):312-19; Nature 29:16-17; Tijdschr. Nederl. Dierk. Vereen. 3:309-16; Feuille des Jeunes Natur. 19:17-19; Tijdschr. Nederl. Dierk. Vereen. 2(19):21-45; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; VAUGHAN 1937.

*Wijster* (Drenthe): **Biologisch Station te Wijster:** — In the most extensive heath- and moor-land district of the Netherlands. Founded in 1927 by Dr. W. BEIJERINCK and now sponsored by the Netherlands Biological Station, an autonomous institution. There is good equipment for field research. — The scientific work originating from the station is marked, Mededeelingen van het Biologisch Station te Wijster. — *Cf.* Botany in the Netherlands, Sixth Int. Bot. Congr. 1935:80; Vakl. Biol. 19(2):17-25.

## — *NETHERLANDS EAST INDIES* —

*Batavia* (Java): **Laboratorium voor het Onderzoek der Zee:** — Adjacent to salt- and brackish-water communities, coral reefs, and mangrove. Sponsored by the Netherlands East Indies Government and managed by the Botanical Gardens of Buitenzorg for scientific marine investigations. There are ample laboratory facilities. — *Cf.* Int. Rev. Hydrobiol. 10:195-96; Annales du Jardin Botanique de Buitenzorg 45:121-28; Natuurkundig Tijdschrift voor Nederlandsch-Indië 97:111-20; VAUGHAN 1934; VAUGHAN 1937.

*Buitenzorg* (Java): **Treub Laboratory** (Visitors' Laboratory) **of the Govt. Botanical Gardens:** — In the midst of the tropical lowland vegetation of 's Lands Plantentuin. Founded in 1884-85 by Prof. M. TREUB and now sponsored by the Botanical Gardens of Buitenzorg for use by foreign scientists who want to do laboratory work in the Botanical Gardens. — *Cf.* Bot. Ztg. 42:752-61, 768-80, 784-91; Pop. Sci. Mon. 67:579-89; Science 80:33-34; Ann. Jard. Bot. Buitenz. 45:1-60; Chronica Botanica 1935; *Ibid.* 1936; "Science and Scientists in the Netherlands Indies," p. 59, 1945.

*Tjibodas* (near Sindanglaija, W. Java): **Mountain Gardens and Biological Laboratory of the Govt. Botanical Gardens:** — Near the virgin forest (elevation between

4,500 and 9.800 feet). Founded in 1891 by Prof. M. TREUB and now sponsored by the Botanical Gardens of Buitenzorg. Laboratory and living accommodations are available.—*Cf.* Revue générale Scientifique 46:631-37, 664-68; Chronica Botanica 1935; "Science and Scientists in the Netherlands Indies," p. 403, *seq.*, 1945.

## —*NEW CALEDONIA*—

*Nouméa:* **Marine Station:**—*Cf.* VAUGHAN 1934.

## —*NEW ZEALAND*—

*Portobello:* **Portobello Marine Biological Station:**—Sponsored by the government of New Zealand for the study of New Zealand marine life. The buildings contain a public aquarium, library, scientific sales department, and laboratories.—*Cf.* VAUGHAN 1937.

## —*NORWAY*—

*Drøbak:* **Universitets Biologiske Stasjon, Drøbak:**—Established in 1892 and now sponsored by the University of Oslo for marine research. Prof. HJALMAR BROCH directs the work of the station, which is housed in a 3-story building. Station open during July and August to students and investigators.—*Cf.* Dtsch. med. Wschr. 20:879; Nyt Mag. Naturv. 42:32; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Herdla:* **Bergens Museums Biologiske Stasjon:**—Types of all prominent ecological habitats of the Norwegian Coast can be reached from this station within two hours. Founded in 1891 and now sponsored by the Bergen Museum for instruction and research in marine biology. Prof. AUGUST BRINKMANN is director of the station which has an annual budget of 25,000 Kroner. The 2-story building contains classrooms, living quarters, library, and several kinds of laboratories. The 48-foot vessel, Herman Friele, is available for research.—*Cf.* Bergens Museums Aarsberetning 1890(5):1-31; Bergens Museums Aarbok 1892(5):1-8; Zool. Anz. 16:217-20; Int. Rev. Hydrobiol. 1:299-300; Nature 111:358; Science 58:24-25; Int. Rev. Hydrobiol. 11:221; Bergens Museums Aarbok 1921-22(1):1-28; Bergens Museums Aarsberetning 1931-32:58-60; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; VAUGHAN 1937.

*Tromsø:* **Biological and Hydrographic Laboratory of the Tromsø Museum:**—Established in 1930 by Mr. T. SOOT-RYEN and sponsored by the Tromsø Museum for scientific marine investigations in northern Norway. Space is available in the building of the Tromsø Museum and the 38-foot Sparre Schneider is available.—*Cf.* VAUGHAN 1937.

*Trondheim:* **Trondheims Biologiske Stasjon:**—An autonomous institution, subsidized by the Norwegian Government for the purpose of making hydrographical and biological investigations in the fiords and coasts of Norway.—*Cf.* Ann. Mag. Nat. Hist. 12:341-67; *Ibid.* 13:112-33, 150-64, 267-83; *Ibid.* 15:476-94; VAUGHAN 1937.

## —*PANAMA (CANAL ZONE)*—

*Gatun Lake:* **Barro Colorado Island Biological Laboratory:**—On an island (six miles square with over 25 miles of shore line) largely covered with primeval rain forest (lower tropical zone). Established in 1924 and now sponsored by the Board of Directors of the Canal Zone Biological Area. Investigators desiring to visit the laboratory must obtain credentials from the Directors; this entitles them to secure steamship concessions, a pass on the Panama Railroad, and other privileges.—*Station publication:* Annual Report of the Barro Colorado Island Biological Laboratory (1926- ).—*Cf.* Science 59:521-22; Jour. Hered. 15:99-112; Nation's Health 6(7):489-90; Science 62:111; Report of the Smithsonian Institution for 1926:327-42; Science 72:457; Nature Mag. 15:11-15; Atlantic Monthly 145:749-58; Wilson Bull. 42:225-32; Bull. Pan-American Union 67:43-51; Entomologist 66:217-21; Travel 63(2)15-19; Revue des Deux Mondes 25:30-34; Survey Graphic 24(4):192-93; Scientific Monthly 47:364-69.

## —*PHILIPPINE ISLANDS*—

*Puerto Galera* (Island of Mindoro): **Puerto Galera Marine Biological Laboratory of the University of the Philippines:**—Sponsored by the Univ. of the Philippines

to provide biologists place and equipment for carrying out investigations on marine animals and plants. Mr. HILARIO A. ROXAS directs the work of the station, which offers both laboratory and living accommodations to students and investigators. — *Cf.* Int. Rev. Hydrobiol. 5:183; *Ibid.* 6:325-34; VAUGHAN 1934; VAUGHAN 1937.

*— POLAND —*

*Hel:* **Station Maritime de Hel:** — Founded in 1932 and now sponsored by the Ministry of Public Instruction and the Ministry of Commerce. — *Cf.* Chronica Botanica 1936.

*Pińsk:* **Poleska Stacja Biologiczna w Pinsku:** — In a vast marshy plain among many slow-running rivers. Sponsored by the Nencki Institute of Biology to study the limnological problems of rivers and marshes. Dr. JERZY WISZNIEWSKI directs the work of the station, which is housed in a 2-story building. A vacation course in hydrobiology is given. — *Cf.* Archives d'Hydrobiologie et d'Ichthyologie 10(4):431-34, 434-36; Chronica Botanica 1938.

*Suwalki:* **Stacji Hydrobiologicznej na Wigrach:** — On the shores of Lake Wigry, one of a group of more than 20 post-glacial lakes in the area. Sponsored by the Ministry of Education for the study of freshwater problems. Dr. ALFRED LITYŃSKI directs the work of the station, which has an annual budget of 30,000 zloty. A course is given in theoretical limnology. — *Station publication:* Archiwum Hydrobiologyi i Rybactwa (1926- ). — *Cf.* LENZ 1927.

*— PORTUGAL —*

*Dafundo:* **Aquário Vasco da Gama—Estação de Biologia Maritima:** — Supported by the Fisheries Administration of the Ministry of Marine for general marine research on the coast of Portugal. There is a public aquarium, well-equipped laboratories, and the 135-ton research ship, Albacora. — *Station publication:* Travaux de la Station de Biologie Maritime de Lisbonne. — *Cf.* MAGRINI 1927; VAUGHAN 1937.

*Porto:* **Station de Zoologie Maritime "Augusto Nobre".**

*— RHODES —*

*Rodi:* **Istituto di Ricerche Biologiche in Rodi:** — An island in the Aegean Sea at the eastern end of the Mediterranean. Founded in 1936 and now sponsored by several Italian governmental agencies for research in the oceanographical, biological, and chemical sciences. The modern, 2-story building contains a large public aquarium, museum, library, and research laboratories. — *Cf.* VAUGHAN 1937.

*— ROUMANIA —*

*Agigea:* **Statiunea Zoologica Maritima "Regele Ferdinand I":** — Sponsored jointly by the Roumanian Ministry of National Education and the Laboratory of Zoology of the University of Iaşi for investigating the fauna of the Black Sea and neighboring lakes. Prof. C. MOTAS directs the work of the station, which is housed in a 2-story building. Station open from June first to October first.—*Station publication:* Lucrările Statiei Zoologice Maritime "Regele Ferdinand I" dela Agigea (1938- ). — *Cf.* Ann. Soc. Univ. Jassy 19:1-16; Buletinuel Soc. Natur. din România 11:1-6; Ann. Scient. de l'Univ. de Jassy 23(2):1-4; VAUGHAN 1937.

*Mamaia:* **Statiunea Bio-oceanografica dela Mamaia.**

*Sinaia* (Cumpatul): **Statiunea Zoologica din Sinaia:** — At an elevation of 2,788 feet in a forested zone with much rainfall. Sponsored by the Ministry of National Education for the study of the fauna and flora of the region of Mount Bucegi. Prof. A. POPOVICI-BAZNOSANU directs the work of the station, which is open from June first to November first. — *Cf.* LENZ 1927.

*Stâna de Vale* (Bihor): **Statiunea Botanica Stâna de Vale:** — Sponsored by the Botanical Institute of the University of Cluj for biological studies on the flora and vegetation of the Bihor Mountains and the cultivation of alpine plants at an altitude of 3,608 feet. A course is given in phytosociology. The station is open during July and August.

## — *SCOTLAND* —

*Millport* (Buteshire) : **Marine Biological Station of the Scottish Marine Biological Association:** — Founded in 1884-85 by Sir JOHN MURRAY and now sponsored by the Scottish Marine Biological Association to investigate the flora and fauna of the Clyde Sea area and provide facilities for research and study for students and others interested in such work. RICHARD ELMHIRST directs the work of the station, which has an annual budget of £4,261. The 2-story buildings contain a public aquarium, museum, offices, storeroom for sales department, library, classroom, and many well-equipped laboratories. The 40-foot vessel, M. B. Nautilus, is available and is equipped with a laboratory for three persons. Several courses are given. — *Station publications:* Annual Report of the Scottish Marine Biological Association; Price List of Specimens. — *Cf.* Jour. Marine Biol. Assoc. United Kingdom 1:218-43; Nature 72:456; JUDAY 1910; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

## — *SPAIN** —

*Chico:* **Estación de Biología Marítima.**

*Las Palmas* (Canary Islands) : **Laboratorio Oceanográfico de Canarias:** — Sponsored by the Spanish Institute of Oceanography for the systematic investigation of the oceanographic and biological conditions in the vicinity of the Canary Islands. — *Cf.* Instituto Espan. Oceanogr. Notas y Resúmenes 2(48) :1-79; VAUGHAN 1937.

*Málaga:* **Laboratorio de Málaga — Instituto Español de Oceanografía:** — Founded on the Strait of Gibraltar in 1914 by Prof. ODÓN DE BUEN and now sponsored by the Spanish Institute of Oceanography for research in marine biology and oceanography. — *Cf.* VAUGHAN 1937.

*Palma* (Island of Mallorca, Balearic Islands) : **Laboratorio Oceanográfico de Palma de Mallorca:** — Founded in 1906-07 by Prof. ODÓN DE BUEN and now sponsored by the Spanish Institute of Oceanography. The station is equipped with aquarium, museum, library, and several laboratories. — *Cf.* Bull. Soc. Zool. France 33:1-11; Int. Rev. Hydrobiol. 30:385-86; KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*San Sebastian:* **Sociedad de Oceanografía de Guipuzcoa:** — *Cf.* MAGRINI 1927; VAUGHAN 1937.

*Santander:* **Laboratorio de Santander — Instituto Español de Oceanografía:** — Sponsored by the Spanish Institute of Oceanography to study the flora and fauna of the coastal regions of the Bay of Biscay. — *Cf.* KOFOID 1910; MAGRINI 1927; VAUGHAN 1937.

*Valencia:* **Laboratorio de Hidrobiología:** — *Cf.* Int. Rev. Hydrobiol. 7:272-73; LENZ 1927.

*Vigo:* **Laboratorio de Vigo — Instituto Español de Oceanografía:** — *Cf.* VAUGHAN 1937.

## — *SURINAM* (*Neth. Guiana*) —

*Paramaribo:* **Biological Station at the General Agricultural Experiment Station:** — Established in 1903 under the directorship of C. J. J. VAN HALL. The present director, Dr. G. STAHEL, is anxious to help visiting biologists. Modern laboratory facilities. *Cf.* Bot. Gaz. 36:238-239; Bot. Cbl. 92:371; West-Ind. Gids, June 1920.

## — *SWEDEN* —

*Abisko:* **Abisko Naturvetenskapliga Station:** — *Cf.* Chronica Botanica 1935.

*Aneboda* (Ugglehult) : **Limnologiska Laboratoriet i Aneboda:** — Founded in 1907-08 and now sponsored by the University of Lund for research and instruction in limnology. A small, 2-story building contains apparatus for limnological research. — *Cf.* Int. Rev. Hydrobiol. 1:745-46; *Ibid.* 2:331-32; *Ibid.* 22:272; LENZ 1927.

*Barsebäckshamn:* **Barsebäckshamns Havsbiologiska Station:** — On the Oresund Sound, with brackish water on the surface and salt water beneath. Founded in 1914 and now sponsored by the Zoological Institute of the University of Lund for research and instruction in marine biology. A course in marine biology is given at the station, which is open to investigators during June, July, and August. — *Station publication:*

* As of June 1936.

Kungl. Fysiografiska Sällskapets Handlingar, Lund, Series: Undersökningar över Oresund. — *Cf.* Chronica Botanica 1936.

*Fiskebäckskil:* **Kristinebergs Zoologiska Station:** — Near the mouth of Gullmar Fiord, a relatively deep bay with a belt of islands near its mouth. Established in 1877 by Prof. SVEN LOVÉN and now sponsored by the Royal Swedish Academy of Science for research and instruction in marine zoology. Prof. EINAR LÖNNBERG directs the work of the station, which has an annual budget of 27,262 kronen. The equipment includes a library, aquarium, darkrooms, living accommodations, several laboratories, and the 42-foot motorboat, Sven Lovén. Course work in marine zoology is given.— *Cf.* Natural Science 7(6):407-16; Ark. f. Zool. 4(5):1-136; Popular Science Monthly 76:125-35; SAND 1898; JUDAY 1910; KOFOID 1910; Chronica Botanica 1936; VAUGHAN 1937.

*Fiskebäckskil:* **Klubbans Biologiska Station:** — At the mouth of the Gullmar Fiord (with a maximum depth of 394 feet) on the coast of the Skagerak. Established by the University of Uppsala for instruction of university students in marine zoology. Prof. SVEN EKMAN directs the work of the station, which is solely to offer course work in marine zoology to university students. — *Cf.* VAUGHAN 1937.

*Göteborg:* **Oceanografiska Institutionen vid Göteborgs:** — Sponsored by the Royal Society of Göteborg for research and instruction in physical oceanography and related sciences. Dr. HANS PETTERSSON directs the scientific work of the station, which is housed in a new, 2-story building. Special equipment includes a hydrodynamic tank (17 × 2 × 1 meters) and a plankton shaft (2 meters in diameter and 12 meters in length). The station is not open during July and August. — *Station publication:* Meddelanden fran Oceanografiska Institutet vid Göteborg (1939- ). — *Cf.* Nature 145:698; VAUGHAN 1937.

## — *SWITZERLAND* —

*Bourg St. Pierre* (Valais): **La Linnaea—Jardin et Laboratoire Alpins:** — In a valley of the Alps at an altitude of 5,576 feet, the region containing a mixture of both an arctic and Mediterranean flora. Founded in 1883, and now sponsored by the Institute of General Botany of the University of Geneva for research and instruction in alpine botany. Prof. FERDINAND CHODAT directs the work of the station, which consists of a botanical garden with 2,000 species of alpine plants and a laboratory building. A course is given in the botany of the Alps. The station is open during July and August. — *Station publication:* La Linnaea — Jardin et Laboratoire Alpins (an announcement in French). — *Cf.* Chronica Botanica 1936.

*Davos:* **Hydrobiologisches Laboratorium der Landschaft Davos:** — *Cf.* LENZ 1927; Chronica Botanica 1936.

*Interlaken:* **Alpengarten und Laboratorium "Schynige Platte":** —*Cf.* Chronica Botanica 1935.

*Jungfraujoch* (Berner Oberland): **Hochalpine Forschungsstation Jungfraujoch:** — In a high, mountainous region at an elevation of 11,340 feet. Established by an autonomous council to enable research work in all branches of science to be carried out under the best possible conditions in a high mountain region. Prof. A. V. MURALT directs the work of the station, which has an annual budget of 24,000 Swiss francs. The 5-story building constructed in solid rock contains living quarters, darkrooms, library, lecture-room, workshop, and several well-equipped laboratories. Application for permission to work at the station must be made through one of the participating societies (Schweizerische Naturforschende Gesellschaft; Kaiser Wilhelm-Gesellschaft, Berlin; Université de Paris; Royal Society, London; Akademie der Wissenschaften, Wien; Fonds National de la Recherche Scientifique, Bruxelles; Rockefeller Foundation, New York; and Jungfraubahn-Gesellschaft, Berne). Investigators whose applications are approved receive a reduction in railway fares and exemption from customs duty on consignments of scientific apparatus entering Switzerland. — *Station publication:* Information and Regulations. — *Cf.* Chronica Botanica 1935.

*Kastanienbaum* (Horw): **Hydrobiologisches Laboratorium der Naturf. Gesellschaft Luzern:** — *Cf.* Arch. f. Hydrobiol. 10:113-18; Int. Rev. Hydrobiol. 9:236; Chronica Botanica 1935; *Ibid.* 1939; LENZ 1927.

*Zürich:* **Geobotanisches Forschungsinstitut Rübel:** — Established in 1918 by Dr. E. RÜBEL and now an autonomous institution for studies in plant taxonomy and ecology. The headquarters and equipment are at Zürich, but the course in the ecology of alpine

vegetation is given at Davos. — *Station publications:* Bericht über das Geobotanische Forschungsinstituts Rübel in Zürich; Veröffentlichungen des Geobotanischen Forschungsinstituts Rübel in Zürich.

— *TUNISIA* —

*Salammbó:* **Station Océanographique de Salammbó:** — Sponsored by the Direction Générale des Travaux Publics in Tunis to investigate the marine organisms along the coast of Tunisia. The equipment includes a public museum and aquarium, library, and several laboratories. — *Station publications:* Notes de la Station Océanographique de Salammbó; Bulletin de la Station Océanographique de Salammbó; Annales de la Station Océanographique de Salammbó; Illustrated Catalogue of the Museum and Aquarium. — *Cf.* Science 63:488; MAGRINI 1927; VAUGHAN 1937.

— *UNION OF SOCIALIST SOVIET REPUBLICS* —

*Alt-Peterhof:* **Hydrobiological Section of the Scientific Institute at Peterhof:** — Sponsored by the Ministry of Education for hydrobiological and hydrochemical investigation of animals. — *Station publication:* Travaux de l'Institut des Sciences Naturelles de Peterhof (1925- ). — *Cf.* Chronica Botanica 1936; LENZ 1927.

*Archangel:* **Algological Research Station:** — *Cf.* Chronica Botanica 1936.

*Cherson:* **All-Ukrainian Scientific-Practical Station of the Black and Asov Seas:** — Founded in 1918 and now sponsored by the Ministry of Agriculture of the Ukraine Republic. — *Station publications:* Bulletin der Allukrainischen wissenschaftlich-praktischen Staatsstation des Schwarzen und des Azowschen Meeres; Arbeiten der Allukrainischen wissenschaftlich-praktischen Staatsstation des Schwarzen und des Azowschen Meeres (1925- ). — *Cf.* LENZ 1927.

*Elenowka* (Armenia): **Sewan Lake Station:** — On Lake Goktscha in the Caucasus Mountains. Sponsored by the Ministry of Agriculture of the Armenian Republic for theoretical and practical investigations of Lake Goktscha. — *Station publication:* Arbeiten der Sewanseestation. — *Cf.* LENZ 1927.

*Kossino:* **Biological Station at Kossino:** — Founded in 1908 and now sponsored jointly by the Moscow Society of Nature Research and the Ministry of Education for theoretical investigations in biology. Prof. L. ROSSOLIMO directs the work of the station, which is housed in a 2-story building. — *Station publication:* Arbeiten der Biologischen Station zu Kossino (1924- ). — *Cf.* Int. Rev. Hydrobiol. 17:386-87; *Ibid.* 25:303-04; Progressive Fish Culturist 34:12-14; LENZ 1927.

*Kostroma:* **Biological Station of the Scientific Society for the Investigation of the Kostroma Region:** — Founded in 1919 and now dedicated to theoretical research work on the Volga River. — *Station publication:* Arbeiten der Wissenschaftlichen Gesellschaft zur Erforschung des Lokalgebietes Kostroma. — *Cf.* LENZ 1927.

*Krasnoyarsk* (Siberia): **Siberian Ichthyological Laboratory:** —Sponsored by the Ministry of Agriculture for practical and theoretical investigations. — *Station publication:* Report of the Ichthyological Laboratory in Siberia. — *Cf.* Int. Rev. Hydrobiol. 11:391-92; LENZ 1927.

*Lake Glubokoje:* **Hydrobiological Station on Lake Glubokoje:** — Founded in 1888 and now managed by the Biological Station at Kossino for the Moscow Society of Naturalists. — *Station publication:* Arbeiten der Hydrobiologischen Station am See Glubokoje (1900- ). — *Cf.* Trav. Soc. Imp. Acclim. 2:201-06; KOFOID 1910; LENZ 1927.

*Maritui:* **Baikal Hydrobiological Station:** — On Lake Baikal, one of the deepest lakes in the world (with a reputed depth of 4,725 feet). Sponsored by the Russian Academy of Sciences for theoretical and practical investigations. — *Station publication:* Arbeiten der Kommission für die Erforschung der Baikalsees. — *Cf.* LENZ 1927.

*Mount Elbrus* (Caucasus): **Institute of Research in High Altitudes:** — *Cf.* Science 87:550.

*Murman:* **Biological Station of the Academy of Sciences of the U. S. S. R. at Murman:** — On the Arctic Ocean which, owing to the penetration of the warm waters of the Atlantic, has an extremely rich and diverse fauna. Established in 1881 near Archangel, moved to near present site in 1899, and an announcement made in 1937 of plans to build a new station in the region to cost three and one-half million rubles. Sponsored by the Academy of Sciences of the U. S. S. R. with Prof. S. A. ZERNOV as

director. — *Cf.* Zool. Anz. 29:704-07; Ohio Naturalist 8:340-42; Int. Rev. Hydrobiol. 2:499-502; *Ibid.* 11:222-23; Science 67:158-59; *Ibid.* 85:536; Nature 139:725; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; VAUGHAN 1937.

*Murom, Vladimir:* **Oka Biological Station:** — Founded in 1918 and now sponsored by the Ministry of Education for theoretical and practical biological investigations. — *Station publication:* Arbeiten der Biologischen Oka-Station (Murom-Russland). — *Cf.* LENZ 1927.

*Novorossiisk:* **Novorossiisk Biological Station:** — Sponsored by the People's Commissariat of Education to investigate the practical problems and objects of the Black Sea. Mr. W. A. WODJANITZKY directs the work of the station, which has an annual budget of 66,200 rubles.—*Station publication:* Arbeiten der Biologischen Noworossijsk-Station. — *Cf.* LENZ 1927; VAUGHAN 1937.

*Otusy* (Krim): **Scientific Station of the Moscow Nature Research Society:** — *Cf.* Chronica Botanica 1935.

*Perm:* **Biological Station at Perm on the Kama River:** — Sponsored by the Biological-Scientific Research Institute of the University of Perm. — *Station publication:* Bulletin de l'Institut des Recherches biologiques et de la Station Biologique à l'Université de Perm. — *Cf.* LENZ 1927.

*Petrosavodsk:* **Borodin Hydrobiological Research Institute:** — *Cf.* KOFOID 1910; LENZ 1927.

*Preobrazenie* (Siberia): **Algological Research Station:** — *Cf.* Chronica Botanica 1935.

*Saratov:* **Volga Biological Station at Saratov:** — Founded in 1900 and now directed by Dr. A. BEHNING for scientific investigation of the life of the Volga and educational work in hydrobiology. Course work is given to students. — *Station publications:* Arbeiten der Biologischen Wolgastation (1900- ); Monographien der Biologischen Wolgastation (1924- ). — *Cf.* Int. Rev. Hydrobiol. 3:461-62; *Ibid.* 5:581-93; Rivista di Biologia 5:789-90; Int. Rev. Hydrobiol. 13:111-13; *Ibid.* 17:357-61; Rev. Algol. 4:77-80; JUDAY 1910; KOFOID 1910; LENZ 1927.

*Sevastopol:* **Sevastopol Biological Station:** — Sponsored by the Academy of Sciences of the U. S. S. R. for oceanographical and hydrobiological observations of the Black and Asov seas. The 3-story building contains a public aquarium, library, darkroom, and several well-equipped laboratories. Course work is given to university students. — *Station publication:* Memoirs of the Sevastopol Biological Station. — *Cf.* Bull. Biol. 1:280-85; Int. Rev. Hydrobiol. 1:861-63; *Ibid.* 9:555; DEAN 1894; SAND 1898; JUDAY 1910; KOFOID 1910; VAUGHAN 1937.

*Starosselje* (Ukraine): **Biological Station of the Dnieper:** — Founded in 1907 and now sponsored by the All-Ukraine Academy of Sciences for theoretical investigation of the Dnieper basin. — *Station publication:* Travaux de la Station Biologique du Dnieper (1926- ). — *Cf.* LENZ 1927.

*Swenigorod:* **Hydrophysiological Station at Swenigorod on the Moskva:** — Sponsored by the National Scientific Institute of the Ministry of Health for theoretical research on the Moskva River. Prof. S. SKADOWSKY directs the work of the station.— *Cf.* LENZ 1927.

*Vladikavkaz* (Caucasus): **North Caucasus Hydrobiological Station:** — Established in 1923 for theoretical hydrobiological investigation of alpine waters. — *Station publication:* Travaux de la Station Biologique du Cauc. du Nord (1925- ). — *Cf.* LENZ 1927.

*Vladivostok:* **Pacific Institute of Fisheries and Oceanography:** — Near Ussuri Bay which is free from ice during the winter. Founded in 1925 under the direction of Prof. K. M. DERJUGIN and now sponsored by the All-Union Scientific Research Institution of Marine Fisheries and Oceanography for researches in the hydrology, hydrobiology, and ichthyology of the region. The plant contains a museum, aquarium, library, and several laboratories. — *Cf.* Int. Rev. Hydrobiol. 15:396-400; Fifth Pacific Science Congress 1:619-22; VAUGHAN 1934; VAUGHAN 1937.

## — *UNION OF SOUTH AFRICA* —

*Frankenwald:* **Botanical Research Station of the University of Witwatersrand:** — *Cf.* Chronica Botanica 1939.

*Sea Point:* **Marine Biological Station of the Division of Fisheries:**—On the western side of the Cape Peninsula, with admirable opportunities for the study of marine flora and fauna. Established in 1939 by the Division of Fisheries of the Department of Commerce and Industry, being partially a continuation of the biological station founded in 1895 at St. James on False Bay. Dr. CECIL VON BONDE directs the work of the station, which has an annual budget of £13,000. The plant contains a library, darkroom, public aquarium, several laboratories, the 136-foot, 313-ton steam survey vessel, Africana, and a 50-foot motorboat, Impala.—*Station publications:* Annual Report of the Division of Fisheries; Investigation Reports.—*Cf.* VAUGHAN 1937.

## —*UNITED STATES OF AMERICA*—

### —*Arizona*—

*Flagstaff:* **San Francisco Mountain Zoological Station:**—At an altitude of 7,100 feet. Founded in 1926 by HAROLD S. COLTON and now sponsored by the Northern Arizona Society of Science and Art to form a center from which the biology, geology, ethnology, and archaeology of the Plateau of Northern Arizona may be studied. The station makes use of the facilities of the Museum of Northern Arizona. Open from June to September.—*Cf.* Science 69:132; Turtox 1932.

### —*California*—

*Angwin:* **Pacific Union College Field Nature School:**—An itinerant field school, with headquarters at Pacific Union College. Prof. HAROLD W. CLARK directs the work of the school, which offers a course in field nature study every other summer.—*Cf.* Turtox 1937.

*Corona Del Mar:* **Kerckhoff Marine Laboratory:**—Sponsored by the California Institute of Technology for research in experimental embryology, physiology, marine ecology, biophysics, and chemistry to supplement that done at the sponsoring institution. Prof. G. E. MACGINITIE directs the work of the station, which is housed in a 2-story building.—*Cf.* VAUGHAN 1934; VAUGHAN 1937.

*Dillon Beach:* **Pacific Marine Laboratory:**—Founded in 1933 by the College of the Pacific for instruction and research in marine biology. Prof. ALDEN E. NOBLE directs the work of the station, which is open from June to September. Summer course work is given in general zoology and invertebrate zoology.

*Laguna Beach* (Orange County): **Laguna Beach Marine Laboratory:**—Founded in 1911 by Prof. C. F. BAKER and now sponsored by Pomona College for summer instruction in biology for undergraduate and graduate students. Prof. WILLIAM A. HILTON directs the work of the station, which is open during the summer months only. Summer course work is offered in the biology of vertebrates and invertebrates, human biology, human origins, and animal ecology.—*Cf.* Int. Rev. Hydrobiol. 7:134-35; Science 39:200-02; The Biologist 18:86-87; MAGRINI 1927; VAUGHAN 1934; VAUGHAN 1937; Turtox 1937.

*La Jolla:* **Scripps Institution of Oceanography:**—Within collecting range of the institution are long stretches of sandy shores interspersed with rocky reefs exposed to the open sea. Founded in 1892 by Dr. WILLIAM E. RITTER at Pacific Grove and moved to present site in 1905. Sponsored by the University of California for research and graduate instruction in oceanography and marine biology. Dr. HARALD U. SVERDRUP directs the work of the station, which has an annual budget of $110,000. The resident scientific staff consists of 12 persons. The equipment includes a public aquarium, 24 cottage residences, seismograph room, museum, offices, library, assembly room, many laboratories, a re-enforced concrete pier, and the 104-foot research vessel, E. W. Scripps. Course work is given in marine meteorology, physical oceanography, marine geology, chemical oceanography, marine microbiology, phytoplankton, marine invertebrates, marine biochemistry, and biology of fishes.—*Station publications:* Bulletin of the Scripps Institution of Oceanography of the University of California, Technical Series (1927- ); annual reports on the activity of the institution appear in the Transactions, American Geophysical Union.—*Cf.* Harpers 110:456-63; Science 26:386-88; University of California Chronicle 9:1-7; Int. Rev. Hydrobiol. 1:863-65; University of California Publications in Zoology 9(4):137-248; Pop. Sci. Mon. 86:223-32;

School and Society 3:453-54; Science 63:297; Scientific Monthly 37:371-75; The Collecting Net 11(2):1-5; The Biologist 18:87-96; MAGRINI 1927; VAUGHAN 1934; Turtox 1937; VAUGHAN 1937.

*Norden* (Placer County): **San Francisco State College Science Field Session:** — Sponsored by San Francisco State College to provide opportunity for study in one of California's most attractive localities. Summer course work is given in astronomy, geology, and the flora and fauna of the Sierra. No research facilities.

*Pacific Grove:* **Hopkins Marine Station:** — In the Monterey Bay region, with extraordinarily rich fauna and flora. Founded in 1892 as the Hopkins Seaside Laboratory by DAVID STARR JORDAN, CHARLES HENRY GILBERT, and OLIVER PEEBLES JENKINS. Now sponsored by Stanford University to undertake research in biology, to provide facilities for visiting investigators, and to furnish elementary and advanced instruction in biology. Prof. WALTER K. FISHER directs the work of the station. The equipment includes a small museum, marine shop, library, offices, darkrooms, and many well-equipped laboratories. Summer courses are given in the ecology of marine organisms, marine biology, marine invertebrates, marine fishes, marine algae, general microbiology, comparative physiology, physiology of marine plants, and experimental embryology. — *Station publication:* Annual Bulletin of the Hopkins Marine Station. — *Cf.* Zoe 4:58-63; Natural Science 11:28-35; Overland Monthly n.s. 32:208; Jour. Applied Microscopy and Laboratory Methods 5:1869-75; Pop. Sci. Mon. 86:223-32; Science 47:410-12; Int. Rev. Hydrobiol. 10:547-49; Science 62:76; Scientific Monthly 29:298-303; The Collecting Net 6:65-71; The Biologist 18:96-99; SAND 1898; MAGRINI 1927; VAUGHAN 1934; Turtox 1937; VAUGHAN 1937.

*San Jose:* **West Coast School of Nature Study:** — Founded in 1931 and sponsored by San Jose State College to better prepare teachers for the "nature in the classroom" type of teaching. Prof. P. VICTOR PETERSON directs the work of the school, which is almost wholly in the field, and changes its site frequently. There are no research facilities. — *Cf.* Turtox 1937.

*Santa Barbara:* **Santa Barbara School of Natural Science:** — Sponsored by Santa Barbara State College in order to offer popular summer field courses in nature study for California teachers. No research facilities are available. — *Cf.* TURTOX 1937.

*Yosemite National Park:* **Yosemite School of Field Natural History:** — The fauna and flora of the area are extensive, due to the wide range of topography and elevation (2,000 to 13,000 feet). Founded in 1925 by Dr. HAROLD C. BRYANT and sponsored by the U. S. National Park Service to train students in methods of interpreting living nature and to train naturalists for the National Park Service. Mr. C. A. HARWELL directs the work of the school, which offers a 7-week course in natural history during the summer months. Research facilities are not available. — *Cf.* School and Society 32:590-92; Nature Magazine 19:274; Turtox 1937.

— *Colorado* —

*Cuchara Camps:* **Nature Enjoyment Camp:** — At an altitude of 8,200 feet in the Rocky Mountains. Founded in 1939 and sponsored by the Huerfano Group of the Colorado Mountain Club to train leadership in methods of out-of-door teaching and nature guiding. No research facilities are available.

*Gothic* (Gunnison County): **Rocky Mountain Biological Laboratory:** — In an area comprising about a half million acres of virgin territory, with elevations ranging from 8,000 to 14,000 feet. Founded in 1927 and sponsored by the Rocky Mountain Biological Laboratory, Inc., for research and instruction in subjects best studied in high mountain areas. Dr. JOHN C. JOHNSON directs the work of the station, which consists of 15 buildings and staff residences. Summer courses are given in ecology, field botany, parasitology, and other biological sciences and geology. The laboratory is open from June twentieth to September first. — *Cf.* The Biologist 18:105-08; Turtox 1937.

*Mount Evans:* **Mount Evans Laboratory:** — At the summit of Mount Evans, 14,250 feet above sea level. Founded in 1936 and now sponsored by the University of Denver and the Massachusetts Institute of Technology to study high altitude phenomena. Prof. J. C. STEARNS directs the work of the laboratory, which is equipped

with both scientific and living facilities. The laboratory is open from June to October. —*Cf.* Science 31:220; *Ibid.* 87:431-32; Scientific Monthly 46:242-48.

*Nederland:* **Science Lodge:**—On the flank of Mount Niwot, 9,500 feet above sea level, just below timberline and close to the continental divide. Sponsored by the University of Colorado for actual field experience in geology and biology. Summer courses are given in field biology and many phases of geology. The station is open from the third week of June to the fourth week of August.—*Cf.* Univ. Colorado Bull. 17(1):1-14; Science 56:162-63; The Biologist 18:101-04; Turtox 1937.

—*Connecticut*—

*Lakeville:* **Science of the Out-of-Doors:**—Established by Teachers College of Columbia University to give teachers guidance in the utilization of features in the natural phenomena of the out-of-doors. Prof. F. L. Fitzpatrick directs the work of this school, which offers a 4-week course in field work each summer.—*Cf.* The Biologist 18:109-10; Turtox 1937.

—*Florida*—

*Belle Isle* (Miami Beach): **Belle Isle Laboratory of the University of Miami:**— Located on an island on the auto causeway connecting the cities of Miami and Miami Beach. Within an area readily accessible to the laboratory is found a wide variety of aquatic habitats and the Gulf Stream is only a short distance from land. Established by the University of Miami with Dr. F. C. Walton Smith as director. Ample laboratory accommodations for classes and independent investigators are available and living facilities may be obtained nearby.—*Cf.* Science 98:141-43.

*Englewood:* **Bass Biological Laboratory:**—On Lemon Bay which opens into the Gulf of Mexico. Founded in 1932 by the late John F. Bass, jr. to furnish research facilities to investigators in biological fields where the fauna, flora, and climate play an important rôle in the problems under observation.

*Pensacola:* **Gulf Coast Fisheries Laboratory:**—Offshore the laboratory there are coral reefs and sand, mud, rock, and shell bottoms. Founded in 1937 and sponsored by the United States Fish and Wildlife Service for biological research on fisheries and related problems. Dr. A. E. Hopkins directs the work of the laboratory. The equipment includes a library, museum, dormitory, residences, boat house, several kinds of laboratories, and several boats.—*Cf.* Science 90:11; Proc. Fla. Acad. Sci. 4:175-78.

—*Illinois*—

*Champaign:* **University of Illinois Animal Ecology Study Trip:**—An itinerant field station sponsored by the Department of Zoology of the University of Illinois. Established in 1936 for instruction in animal ecology. Prof. V. E. Shelford directs the work of the study trip, which offers no facilities to investigators.

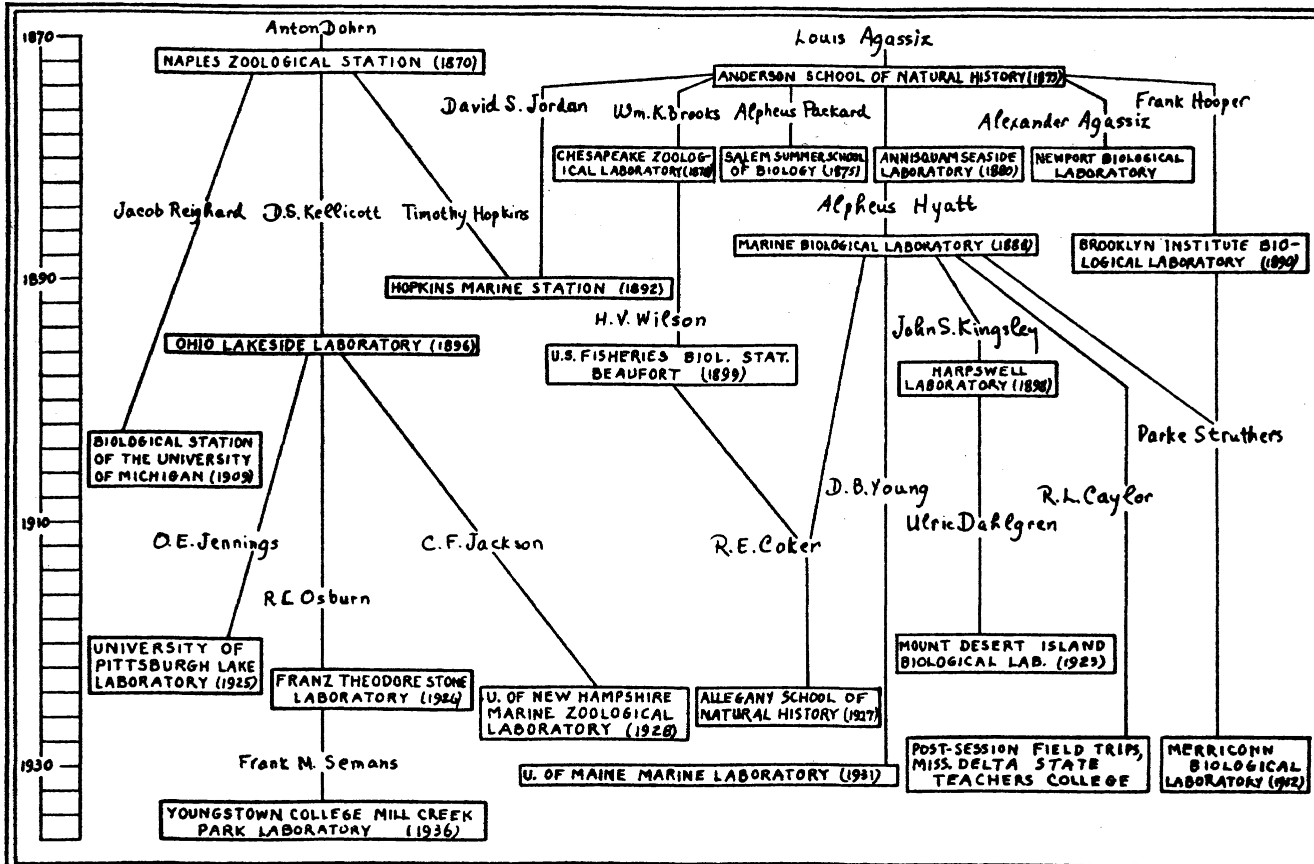
—*Indiana*—

*Winona Lake:* **Indiana University Biological Station:**—Habitats available for study include mesophytic deciduous forests, a variety of glacial lakes in various stages of development and decay, and a medium-sized river. Founded in 1895 by Dr. C. H. Eigenmann and now sponsored by Indiana University for research in most phases of fresh water biology and physics. Dr. William E. Ricker directs the work of the station, which is open during June, July, and August.—*Cf.* Science 10:925-29; Lenz 1927; Turtox 1937.

—*Iowa*—

*McGregor:* **American Institute of Nature Study:**—Founded in 1918 and now sponsored jointly by the Iowa Conservation Commission and the citizens of McGregor for instruction in nature study. Rev. Glenn W. McMichael is executive director of the institute, which gives a 2-week course in nature study each summer.—*Cf.* Turtox 1937.

*Milford:* **Iowa Lakeside Laboratory:**—On West Okoboji Lake, of glacial origin and 132 feet deep with a shoreline of 18 miles. Founded in 1909 and now sponsored by a board of managers from several state and federal agencies for the purpose of studying the hydrology and biology of the State of Iowa. Prof. Joseph H. Bodine is




— GENEALOGY OF UNITED STATES BIOLOGICAL STATIONS —

director of the laboratory. Research, instructional, and living accommodations are available. Summer courses are given in biology and protozoology. The station is open between the second week in June and the third week in August. — *Cf.* Science 49:466-67; The Biologist 18:114-22; LENZ 1927; Turtox 1937.

— *Louisiana* —

*Grand Isle:* **Louisiana State University Field Laboratory:** — On an island at the foot of Barataria Bay, west of the mouth of the Mississippi River, with a fine sand beach on the Gulf of Mexico and mud flats and marshes on Barataria Bay. Sponsored by Louisiana State University for instruction and research on Louisiana marine life. Prof. E. H. BEHRE is director of the laboratory, which consists of one building and a tent colony for living accommodations. Summer course work is given in marine zoology for advanced students and biology teachers. The laboratory is open during June and July. — *Cf.* Turtox 1937.

— *Maine* —

*Damariscotta:* **Audubon Nature Camp:** — Established by the National Audubon Society to offer adult leaders at low cost two-week sessions of ecological study guided by a highly competent and enthusiastic staff of specialists. Mr. CARL W. BUCHHEISTER directs the work of the camp which has an annual budget of $13,000. Facilities are not available to research investigators. — *Cf.* Bird Lore 37:440-41; *Ibid.* 38:3, 36-37, 204-06, 288-92, 348-52; *Ibid.* 39:127-32, 366; Natural History 39:318-28; Nature Magazine 31:212-14; Bird Lore 40:120-22; Turtox 1937.

*Lamoine:* **University of Maine Marine Laboratory:** — Easy access to the unusually rich flora and fauna of the Gulf of Maine. Sponsored by the University of Maine to offer instruction in marine zoology. Prof. JOSEPH M. MURRAY is director of the laboratory, which is open from July first to September first. There are ample research, instructional, and living accommodations. Course-work is given each summer in marine invertebrate zoology. — *Cf.* Science 87:505; Turtox 1937; VAUGHAN 1937.

*Salisbury Cove:* **Mount Desert Island Biological Laboratory:** — Accessible to the Acadian fauna, with tides of eleven to fourteen feet. Founded in 1898 as the Harpswell Laboratory by J. S. KINGSLEY and now sponsored by the Mount Desert Island Biological Laboratory, Inc., to establish and maintain a laboratory for biological study and investigation in the State of Maine. Prof. WILLIAM H. COLE is director of the laboratory, which has an annual budget of $8,000. Equipment includes dining hall, darkroom, library, shop, laboratories, and the 30-foot power boat, Dahlgren. Course work is given each summer in invertebrate zoology. The laboratory is open from June fifteenth to September fifteenth. — *Station publication:* Bulletin of the Mount Desert Island Biological Laboratory. — *Cf.* Science 17:983-86; Popular Science Monthly 74:504-13; Int. Rev. Hydrobiol. 4:537-39; Science 41:603-04; Natural History 22:47-55; The Biologist 18:123-26; Science 87:13; *Ibid.* 92:305; Turtox 1937; VAUGHAN 1937.

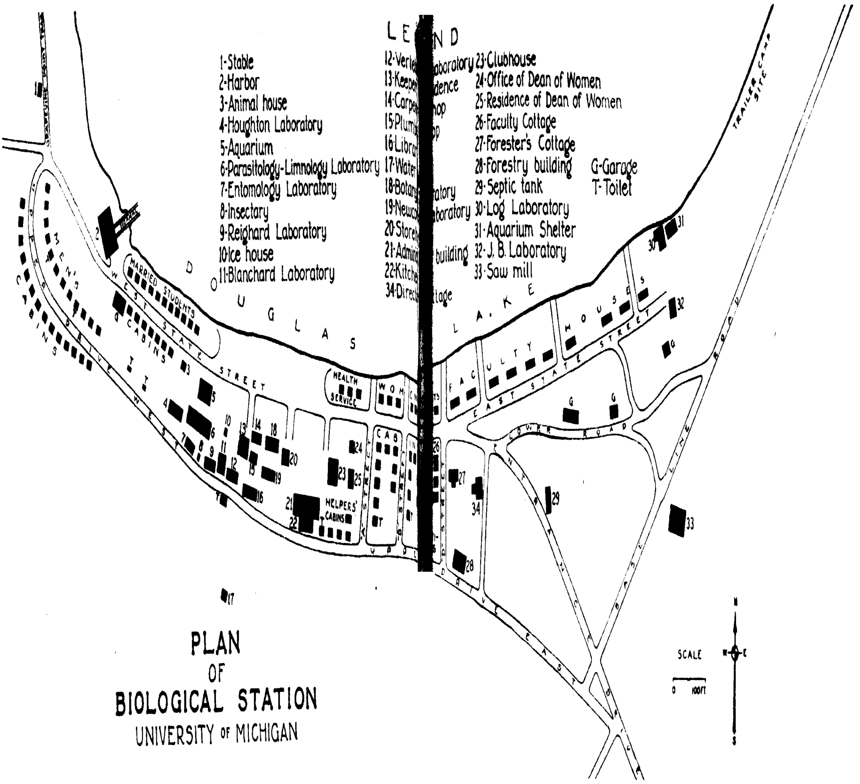
— *Maryland* —

*Solomons Island:* **Chesapeake Biological Laboratory:** — On the western shore of Chesapeake Bay at the mouth of the Patuxent River. Maintained by the State of Maryland as a research and study center where facts tending toward a fuller appreciation of nature may be gathered and disseminated. Prof. R. V. TRUITT is director of the laboratory, which has an annual budget of $21,000. The two, 3-story brick buildings contain offices, museum, classrooms, library, living accommodations, and many well-equipped laboratories. Several types of boats are available. Summer courses are given in economic zoology, invertebrates, invertebrate embryology, and diatoms. — *Station publications:* Bulletin of the Chesapeake Biological Laboratory; Annual Report. — *Cf.* Science 76:205-06. *Ibid.* 85:513-14; The Biologist 18:127-34; Turtox 1937; VAUGHAN 1937.

— *Massachusetts* —

*Plymouth:* **Nature Guide School:** — Sponsored by Massachusetts State College to train outdoor leaders. Prof. WILLIAM G. VINAL is director and founder of the school, which offers a 6-week summer course in nature education. — *Cf.* Turtox 1937.

*Woods Hole:* **Marine Biological Laboratory:** — The fauna and flora are exceptionally rich, there being no muddy river or city sewage to pollute the sea water and




A PLAN OF THE GROUNDS AND BUILDINGS OF THE BIOLOGICAL STATION OF THE U OF MICHIGAN AT CHEBOYGAN LAKE, MICHIGAN (*courtesy Univ. of Michigan*).

the shore being varied by necks, points, flats, gutters, bays, and islands. Founded in 1888 as an outgrowth of the Annisquam Seaside Laboratory with Dr. C. O. WHITMAN as director. It is now an autonomous institution dedicated to the promotion of biological research by supplying investigators with facilities for their work and by offering courses which contribute to the training of investigators. Prof. CHARLES PACKARD is director of the laboratory, which maintains a summer staff of 44 professors. The plant includes a 4-story brick laboratory building, four wooden laboratory buildings, three buildings used by the supply department, carpenter shop, mess hall, club house, dwellings, and dormitories. These contain offices, dark rooms, balance rooms, X-ray rooms, auditorium, museum, many private and general laboratories, and a library, the latter containing 52,000 bound volumes, 130,000 reprints, and 1,300 current scientific periodicals. Summer courses are given in protozoology, invertebrate zoology, embryology, physiology, and the morphology and taxonomy of algae.—*Station publications:* Biological Bulletin (1899- ); Annual Report.—*Cf.* Science 9:382-83; *Ibid.* 11:20-21, 305-06; *Ibid.* 12:37-38; Pop. Sci. Mon. 42:459-71; Science 7:37-44; *Ibid.* 12:233-44; *Ibid.* 16:529-33, 591-92; Smithsonian Report for 1902:625-32; Science 26:839-42; *Ibid.* 28:509-10; School Science and Mathematics 8:337-40; Nature 84:527-28; Int. Rev. Hydrobiol. 5:583-89; Hearst's Magazine 24:784-86; Outlook 107:767-68; Pop. Sci. Mon. 85:203-04; Science 40:229-32; *Ibid.* 58:142-43, 198; New Republic 36:178-79; Science 59:371-72; *Ibid.* 62:26, 271-80; School and Society 26:592-93; Scientific Monthly 27:186-90; Science 70:208-10; *Ibid.* 80:308; Scientific Monthly 39:377-80; The Biologist 18:135-39; Science 88:402; *Ibid.* 89:57-58; Turtox News 18:93-94; Science 92:213; *Ibid.* 94:206; *Ibid.* 95:14; SAND 1898; Turtox 1937; FRANK R. LILLIE: The Woods Hole Marine Biological Laboratory. University of Chicago Press, 284 pp., 1944.

*Woods Hole:* **Woods Hole Oceanographic Institution:**—The nearness of Woods Hole to the transition zone between inshore and oceanic waters, the abruptness of this transition, and the nearness to the continental abyss and ocean basin all make this a particularly favorable headquarters for investigations into many of the basic problems in oceanography that are now engaging scientific attention. Founded in 1930 by an endowment from the Rockefeller Foundation on recommendation of the National Academy of Sciences. It is now an autonomous institution dedicated to the study of oceanography in all its branches. Prof. COLUMBUS ISELIN directs the work of the station, which has an annual budget of $110,000. The 4-story building contains a constant temperature room, machine shop, offices, chart room, library, drafting room, darkrooms, and many well-equipped general and individual laboratories. Boats include the 142-foot research ship, Atlantis, and the 40-foot gasoline launch, Asterias. No instruction is offered, but a limited number of visiting investigators may be accommodated, either at the institution or on the Atlantis.—*Station publications:* Papers in Physical Oceanography and Meteorology (1933- ); Collected Reprints (1933- ); Report for the Year.—*Cf.* Jour. Conseil Int. Explor. Mer 5:226-28; VAUGHAN 1937; FRANK R. LILLIE, The Woods Hole Marine Biological Laboratory. University of Chicago Press, pp. 177-91, 1944.

—*Michigan*—

*Clear Lake* (Montmorency County): **Michigan State College School of Field Biology:**—Sponsored by Michigan State College to train teachers, undergraduates, and graduate students in biology. Prof. JOSEPH W. STACK directs the work of the school.—*Cf.* Turtox News 18(2):40-42; Turtox 1937.

*Cheboygan:* **Biological Station of the University of Michigan:**—On the shores of Douglas Lake, in the transition zone between the evergreen coniferous forest region to the north and the deciduous hardwood forest region to the south. Founded in 1909 and now sponsored by the University of Michigan for teaching and research in botany and zoology. Prof. ALFRED H. STOCKARD is director of the station, which has an

annual budget of $16,500. The faculty consists of eleven professors. There is a well-equipped campus with excellent laboratory and living facilities. Each summer courses are given in the taxonomy of fresh-water algae, taxonomy of the bryophytes, systematic botany, plant anatomy, plant ecology, aquatic flowering plants, plant tissue culture and morphogenesis, entomology, ornithology, ichthyology, natural history of invertebrates, herpetology and mammalogy, limnology, and helminthology. The station is open from June twentieth to September first. — *Cf.* School Science and Mathematics 13:411-15; Science 47:381-83; *Ibid.* 49:466-67; Report of the Michigan Academy of Science, Arts and Letters 22:91-99; Science 57:412-13; The Collecting Net 6:169-73; The Biologist 13:130-37; *Ibid.* 18:140-48; LENZ 1927; Turtox 1937.

— *Minnesota* —

*Itasca State Park:* **Lake Itasca Forestry and Biological Station:** — On the east shore of Lake Itasca, with a diverse series of habitats furnishing a characteristic succession of plants and animals. Sponsored by the University of Minnesota for the advancement of terrestrial and fresh-water biology by means of promoting and providing opportunities for instruction and research. Prof. T. SCHANZ-HANSEN directs the work of the station. There are ample laboratory and living accommodations. Summer courses are given in field taxonomy (botany), field botany, elementary field ecology, bryophytes and pteridophytes, field research methods in ecology, field dendrology, field mycology, field entomology, wildlife conservation, parasitology, natural history of invertebrates and fishes, protozoology, limnology, and helminthology. The station is open from June to October.

— *Mississippi* —

*Biloxi:* **Mississippi Delta State Teachers College Field Botany Trip:** — Sponsored by Mississippi Delta State Teachers College to give instruction in field botany. Prof. R. L. CAYLOR directs the work of the trip, which is housed in a permanent camp on the shore of the Gulf of Mexico. A summer course in field botany is given. — *Cf.* Turtox 1937.

— *New Hampshire* —

*Isles of Shoals:* **Isles of Shoals Marine Zoological Laboratory:**—An excellent base for the study of marine life under a variety of conditions. Established in 1928 by Prof. C. FLOYD JACKSON and now directed by him for the University of New Hampshire. There are ample laboratory and living accommodations on the island. Summer courses are given in comparative anatomy, invertebrate zoology, histology-embryology, marine biology, laboratory technique, and the teaching of biology in secondary schools. The laboratory is open only during the summer months. — *Cf.* The Biologist 18:153-59; Turtox 1937; VAUGHAN 1937.

*Nelson:* **Merriconn Biological Laboratory:** — Founded in 1933 by Prof. PARKE H. STRUTHERS and now maintained by him as a private laboratory open to teachers and advanced students who wish to devote a part of the summer to increase their professional background and investigations in the field of biology. Laboratory and living accommodations are available. Summer courses are given in comparative anatomy, field zoology, and nature training. The laboratory is open to independent investigators from June fifteenth to September fifteenth. — *Cf.* The Biologist 18:111-13; Turtox 1937.

*North Woodstock:* **New Hampshire Nature Camp:** — In a high mountain valley about 1,800 feet above sea level. An autonomous institution under the sponsorship of Mr. LAWRENCE J. WEBSTER to train teachers and others in nature study and in various methods of imparting this knowledge to others. Dr. JARVIS B. HADLEY directs the work of the camp, which offers limited facilities to investigators. — *Cf.* Turtox 1937.

— *New Mexico* —

*Las Vegas:* **Biology Field Courses of Texas Technological College:** — At an altitude of 8,000 feet in a heavily timbered valley surrounded by rather high mountains and mesas. Founded in 1934 and sponsored by Texas Technological College to teach undergraduates biology. Dr. R. A. STUDHALTER is director of the station. Summer course work is given in general biology, although there are no facilities for investigators. — *Cf.* Turtox 1937.

*— New York —*

*Cold Spring Harbor* (Long Island): **Biological Laboratory of the Long Island Biological Association:** — The harbor is not exposed to the surf of Long Island Sound, the result being that marine animals and plants grow near the laboratory in great numbers. Founded in 1890 by Prof. FRANKLIN W. HOOPER with Dr. BASHFORD DEAN as director. The laboratory is now sponsored by an autonomous institution, the Long Island Biological Association, with an annual budget of about $25,000. Dr. M. DEMEREC is director of the laboratory. The equipment includes technical shops, library, animal rooms, many kinds of laboratories, dining room, and dormitories. Summer courses were given in experimental surgery, experimental endocrinology, and marine and fresh water zoology. Each summer the laboratory invites a group of chemists, mathematicians, physicists, and biologists to take part in a 5-week symposium in some selected aspect of quantitative biology. The laboratory closely cooperates with the adjacent Dept. of Genetics of the Carnegie Institution. — *Station publications:* Cold Spring Harbor Symposia on Quantitative Biology (1933- ); Annual Report. — *Cf.* Int. Rev. Hydrobiol. 4:223-26; Science 59:332; *Ibid.* 63:419; Rivista di Biologia 12:150-58; Science 88: suppl. 10; The Collecting Net 15(1):1, 3-4; SAND 1898; Turtox 1937; Science 99:395-397.

[*Quaker Bridge:* **Allegany School of Natural History:**—After a short but influential existence, this institution was abandoned permanently in 1941. — *Cf.* Science 65:201; Playground 21:170; School and Society 27:598-601; *Ibid.* 28:106; *Ibid.* 31:197-98; Elementary School Journal 29:569-70; Bird Lore 35:125-28; School Science and Mathematics 38:67-71.]

*— North Carolina —*

*Beaufort:* **Duke University Marine Station:** — Established by Duke University to study marine biology. Prof. A. S. PEARSE is director. There are three dormitories, a laboratory-building, a boat-house, a dining hall, and the caretaker's residence. Summer courses are given in algae, marine zoology, plant ecology, parasitology, and invertebrate zoology. — *Cf.* Science 87:454.

*Beaufort:* **Fisheries Biological Station at Beaufort, North Carolina:** — Easily accessible are a large variety of aquatic animals and plants, including those living in the open ocean, in brackish water, and in fresh water. Established in 1899 and now sponsored by the United States Fish and Wildlife Service for investigations of marine biology. Dr. HERBERT F. PRYTHERCH is director of the station, which has an annual budget of about $17,000. The eight buildings contain a marine aquarium, museum, dormitory rooms, library, and several types of laboratories. Available boats include a 46-foot cruiser, a 33-foot boat, and an 18-foot outboard motorboat. — *Cf.* Int. Rev. Hydrobiol. 7:122-26; Science 69:547-49; U. S. Bureau of Fisheries Economic Circular 72; MAGRINI 1927; Turtox 1937; VAUGHAN 1937.

*Highlands:* **Highlands Museum and Biological Laboratory:** — Situated abreast of the Blue Ridge at an elevation of 4,000 feet. Established in 1927 and now an autonomous institution to promote, conduct, and maintain biological research in the southern Appalachian Mountains. Prof. W. C. COKER directs the work of the laboratory, which is open during July and August to investigators. — *Station publication:* Publications of the Highlands Museum and Biological Laboratory (1930- ). — *Cf.* Jour. Elisha Mitchell Scientific Society 49:35; Mycologia 25:330-31.

*— Ohio —*

*Put-in-Bay:* **Franz Theodore Stone Laboratory:** — On an island in Lake Erie. Established at Sandusky in 1896 and moved to present site in 1918. Sponsored by Ohio State University in coöperation with the Ohio Division of Conservation and Natural Resources for the development of biological research and the application of its results to the welfare of humanity. Prof. THOMAS H. LANGLOIS directs the work of the station, which maintains a year-round scientific staff of seven persons. There is a well-equipped, 3-story laboratory building and also living accommodations. Summer courses are given in plant taxonomy, plant ecology, fresh water algae, higher aquatic plants, physiology of aquatic plants, advanced entomology, aquatic entomology, climatology, invertebrate zoology, aquiculture, ichthyology, animal parasitology, field

biology, advanced ornithology, herpetology, comparative physiology, and physiology of fishes. — *Station publication:* Contributions from the Franz Theodore Stone Laboratory.— *Cf.* Jour. Applied Micro. 6:2550-553; Science 49:466-69; The Biologist 18:149-52; Science 87:315-16; Turtox 1937.

— *Oregon* —

*Coos Head:* **Oregon Institute of Marine Biology:** — At the entrance to Coos Bay which contains wide stretches of tide-flats interspersed with sandy and rocky beaches. Sponsored by the Oregon State System of Higher Education for instruction and research in marine biology. Prof. EARL L. PACKARD is director. Summer course work is given in field zoology, biology of fishes, embryology of marine invertebrates, invertebrate zoology, taxonomy and ecology of marine algae, morphology of marine algae, systematic botany, paleobiology, and biological science survey. The Institute is open during June and July. — *Cf.* Science 85:240; VAUGHAN 1934; VAUGHAN 1937.

— *Pennsylvania* —

*Bristol Township* (Bucks County): **Effingham B. Morris Biological Farm:** — Sponsored by the Wistar Institute of Anatomy and Biology with Dr. EDMOND J. FARRIS as executive director. Laboratory and living accommodations are available to qualified investigators. — *Cf.* Bull. Wistar Institute of Anatomy and Biology 8:1-31.

*Huntingdon County:* **Pennsylvania State College Nature Camp:** — Founded in 1923 by Prof. GEORGE R. GREEN and now sponsored by Pennsylvania State College to provide outdoor training and experience under expert field naturalists and to satisfy the demands of teachers and nature lovers for practical nature study and science field work. Ample living and laboratory facilities are available for summer course and research work in nature education. — *Cf.* Turtox 1937.

*Presque Isle Peninsula* (Erie County): **University of Pittsburgh Lake Laboratory:** — A peninsula in Lake Erie, with a continuous ecological series of ponds and marshes. Sponsored by the University of Pittsburgh as a field station for research and undergraduate instruction. Prof. O. E. JENNINGS is director of the laboratory, which is housed in a small, wooden building. Summer courses are given in field botany, nature study, field zoology, and entomology. The laboratory is open to investigators from the last week of June to the end of August. — *Cf.* Turtox 1937.

— *Rhode Island* —

*Narragansett:* **Narragansett Laboratory of Rhode Island State College:** — On the shore of Narragansett Bay, in which the winter fauna is predominately boreal and the summer fauna is Virginian with a periodic influx of open ocean and gulf stream forms in late summer. Sponsored by the Rhode Island Division of Fish and Game and Rhode Island State College to offer facilities for marine research. CHARLES J. FISH directs the work of the laboratory, which contains good scientific equipment. The laboratory is open from June fifteenth to September first to investigators. — *Cf.* VAUGHAN 1937.

— *South Dakota* —

*Nemo:* **South Dakota State College Botany Summer Camp:** — In the heart of the Black Hills with a diversity of biological habitats. Sponsored by the Botany Department of South Dakota State College for instruction and research in the taxonomy and ecology of the Black Hills flora. Prof. LEON C. SNYDER is director of the Camp, which is erected on land belonging to the National Forest Service. A summer course is given in the taxonomy of the Black Hills flora. Investigators may work at the camp between the second week of June and the third week of July.

*Waubay:* **Lake Enemy Swim Biological Station:** — Sponsored by Northern State Teachers College to offer the best possible opportunity to teachers, students, and investigators for the study and investigation of problems of the life sciences. Prof. SIDNEY R. LIPSCOMB directs the work of the station, which contains dormitories, dining hall, and a central laboratory building. Summer courses are given in natural science, animal biology, taxonomy of the flowering plants, plant anatomy, eugenics, and animal histology. No facilities are available to investigators. — *Cf.* Turtox 1937.

— *Tennessee* —

*Reelfoot Lake:* **Reelfoot Lake Biological Station:** — On the banks of Reelfoot Lake which was formed by an earthquake in 1815 and with the areas, therefore, definitely dated. Sponsored by the Tennessee Academy of Science to furnish opportunity for research to advanced investigators. Prof. CLINTON L. BAKER is director of the station, which consists of a well-equipped laboratory building. The station is open to investigators from June first to September fifteenth. — *Station publication:* Report of the Reelfoot Lake Biological Station (1937- ). — *Cf.* Jour. Tenn. Acad. Sci. 1:11-15; Science 76:208; Turtox 1937.

— *Utah* —

*Utah Lake:* **Brigham Young University Lakeside Biological Laboratory:** — On a shallow, fresh-water lake with an area of about 75,000 acres. Sponsored by Brigham Young University to study the ecology of the flora and fauna of the lake. Prof. VASCO M. TANNER directs the work of the laboratory, which consists of one laboratory building. — *Cf.* Turtox 1937.

— *Vermont* —

*Newfane:* **Summer School of Bryology:** — The hills of southern Vermont offer a moss and hepatic flora which is unusually abundant. Sponsored by the Long Island Biological Association to instruct students wishing to gain proficiency in the study of mosses. Prof. A. J. GROUT directs the work of the school, which contains a library, laboratory space, and a herbarium of 30,000 specimens. Summer course work of an informal nature is offered in bryology. The school is open to investigators from June to October. — *Station publication:* The Moss Flora of North America, North of Mexico.

*Randolph:* **Green Mountain Nature Camp:** — An autonomous institution directed by M. ELSIE OSGOOD to combine an invigorating, but restful vacation in the open with a chance to study nature first-hand. Informal course work is given during the summer in nature study. Research facilities are not available.

— *Virginia* —

*Chester:* **Virginia Natural History Institute Nature Leaders Training Course:** — Founded in 1940 under the initiative of the National Recreation Association to provide training and practical field experience to leaders and prospective leaders for park, recreational, and camping agencies and educational institutions. REYNOLD E. CARLSON is director of the Course, which is given during the summer. Research facilities are not available.

*Mountain Lake:* **Mountain Lake Biological Station:** — At an altitude of almost 4,000 feet, and within a radius of five miles collections can be made from places with a difference of 2,500 feet in altitude. Founded in 1929 and now sponsored by the University of Virginia to offer facilities for graduate instruction and research in the biological field to qualified students, teachers, and investigators from the Southern States. Prof. IVEY F. LEWIS is director of the station, which has an annual budget of $11,000. Equipment includes a library, herbarium, museum, auditorium, darkrooms, culture rooms, offices, classrooms, dining hall, living cottages, dormitories, and trucks. Summer courses are given in the morphology of seed plants, plant taxonomy, phycology, mycology, protozoology, cell morphology, experimental morphogenesis, and hydrobiology. The station is open to investigators from June fifteenth to September first.— Cf. Science 80:112-13; Life 9:49-51; Turtox 1937.

*Yorktown:* **Virginia Fisheries Laboratory:** — Within easy reach of the James River and only seven miles from the deeper waters of Chesapeake Bay. Established recently by the College of William and Mary and the Commission of Fisheries in Virginia in order to conduct investigations and give instruction in aquatic biology and conservation. Dr. CURTIS L. NEWCOMBE is director of the laboratory. While classwork is done mainly at Williamsburg, research requiring running sea-water is conducted at Yorktown. The 45-foot Agnes Hope is used for off-shore studies.

— *Washington* —

*College Place:* **Walla Walla College Field Nature School:** — Sponsored by Walla Walla College to afford an opportunty for students interested in nature to learn to

understand nature from first-hand observation. An itinerant school, pupils travelling every other summer 800 miles from the Blue Mountains in eastern Oregon down the Columbia River to Mount Rainier. Prof. HAROLD W. CLARK is director of the school, which does not offer research facilities.

*Friday Harbor:* **University of Washington Oceanographic Laboratories:** — The inland waters of the San Juan Archipelago and adjacent territory have a great variety and wealth of marine flora and fauna. Founded in 1904 and now sponsored by the University of Washington for independent research, directed research, and seminar and formal courses in the different phases of oceanography. Prof. THOMAS G. THOMPSON is director of the laboratories, which have an annual budget of $15,000. The equipment includes seven laboratory buildings, stockroom, dining hall, living tents, cantilever pier, 50-foot power boat, Medea, and the 75-foot research vessel, Catalyst. There is also a 3-story laboratory building at Seattle. Summer courses are given in the physiology of bacteria, marine plants, physiology of marine plants, phytoplankton, oceanographic chemistry, physical oceanography, biochemistry of marine life, oceanographic meteorology advanced invertebrate embryology, and advanced invertebrate zoology. Research facilities are available during June, July, and August. — *Station publications:* University of Washington Publications in Oceanography (1932- ); University of Washington Publications in Oceanography, Supplementary Series (1931- ). — *Cf.* Pop. Sci. Mon. 86:223-32; Science 69:331-32; Natural History 36:73-80; Jour. Chemical Education 13:203-09; The Biologist 18:160-70; MAGRINI 1927; VAUGHAN 1934; Turtox 1937; VAUGHAN 1937.

*Seattle:* **University of Washington Field Course in Botany:** — An itinerant station sponsored by the University of Washington to acquaint students with the vegetation of North America and to give University of Washington botanists better access to the less well-known botanical regions of that area. Dr. C. LEO HITCHCOCK directs the work of this field course, which offers formal work in plant taxonomy during the summer. Independent investigators may accompany the course.

### — *West Virginia* —

*Morgantown:* **West Virginia University Biological Expedition:** — An itinerant station sponsored by West Virginia University to complement the ordinary biological courses with outdoor laboratory work. Prof. P. D. STRAUSBAUGH directs the work of the expedition, which offers summer courses in botany and zoology. A limited number of investigators may be accommodated. — *Cf.* the Biologist 18:171-76; Turtox 1937.

*Oglebay Park:* **Oglebay Institute Nature Leaders Training School:** — Sponsored jointly by Oglebay Institute, Wheeling Park Commission, and West Virginia University for practical instruction in the field for nature teachers and others. Mr. A. B. BROOKS directs the work of this school, which offers a series of summer courses in natural history. Research facilities are not available.

### — *Wisconsin* —

*Long Lake:* **Lost Lake Conservation Camp:** — Sponsored by the nine State Teachers Colleges of Wisconsin and the U. S. Forest Service to give teachers and prospective teachers an opportunity to gain a practical knowledge of conservation and an extensive biological background which is essential for this. Prof. THORPE LANGLEY directs the work of the camp, which makes use of former C.C.C. lodges. Summer courses are given in field zoology, field botany, nature study, and conservation. Research facilities are not available.

*Trout Lake:* **Trout Lake Limnological Laboratory:** — Several hundred lakes are found within a radius of 25 miles from the laboratory. Sponsored by the University of Wisconsin and the Wisconsin Conservation Department to study the physics, chemistry, and biology of Wisconsin lakes. Prof. CHANCEY JUDAY is director of the laboratory, which has an annual budget of $15,000. There are ample living and laboratory facilities. No course work is given, but independent investigators may work at the laboratory from June through September. — *Cf.* Trans. Wis. Acad. Sci., Arts, and Letters 25:337-52; The Biologist 18:177-82; Turtox 1937.

*Williams Bay:* **Geneva Lake Summer School of Natural Science:** — An autonomous

institution dedicated to correlate theory and practice by giving students an opportunity for personal observation of the geological formations, plants, and animals of southern Wisconsin. Dr. ARTHUR D. HASLER is director of the School, which has good living and field laboratory facilities. Summer courses are given in plant ecology, advanced plant taxonomy, glacial geology, field geology, field zoology, limnology, survey of astronomy, and the teaching of science. Research facilities are available during the summer months.—*Cf.* Turtox 1937.

*— Wyoming —*

*Centennial:* **University of Wyoming Science Summer Camp:**—In the subalpine zone of the Medicine Bow National Forest at an altitude of 9,500 feet. Founded in 1923 and now sponsored by the University of Wyoming for field instruction and research in botany, geology, and zoology. Prof. S. H. KNIGHT is director of the camp. The equipment includes a central log lodge, four laboratory buildings, and forty lodging cabins. Summer courses are given in fresh-water algae, taxonomy of vascular plants, ecology, field and laboratory general botany, Wyoming birds, aquatic zoology, elementary field and laboratory zoology, elementary field course in geology, and advanced field geology. The camp is open to investigators from June fifteenth to August first.—*Cf.* The Biologist 18:183-89; Turtox 1937.

*Jackson:* **Rocky Mountain Biological Station of the University of Michigan:**—In a rugged mountain area, near the continental watershed. Sponsored by the University of Michigan Summer Session to conduct a general plant survey of the region and explore the possibilities of the region for biological study and research. Prof. LEWIS E. WEHMEYER is director of the station, which makes use of the summer engineering camp of the University of Michigan. No formal courses are given, but research may be undertaken during July and August.

*— VENEZUELA —*

*Rancho Grande* (Maracay): **Biological Station of the New York Zoological Society:**—This has recently been established. Dr. WILLIAM BEEBE writes (May 29, 1945): "As to the permanence of my Rancho Grande, I am only able to say that it looks as if it might be continued. I shall spend ten months next year here, and both the Venezuelan Government and the Creole People as well as our Zoological Society are anxious to have it kept up. I hope to get some of the native scientists trained to carry it on. I should say there is a very fair chance of its being carried on."

*— YUGOSLAVIA —*

*Rab:* **Biological Station of the Czechoslovak Society for a Marine Biological Station:**—Sponsored by the Czechoslovak Society for a Marine Biological Station to enable Czechoslovakian biologists to work in sea biology. There is one building which contains laboratory facilities.—*Station publication:* Travaux (1933- ).—*Cf.* VAUGHAN 1937.

*Split:* **Oceanografski Institut:**—Sponsored by the Government of Yugoslavia for researches in oceanography and biology and instruction for students. Prof. A. ERCEGOVIĆ directs the work of the institute. Equipment includes a public aquarium, library, living accommodations, and 25 laboratories. Courses are given in marine biology.—*Station publications:* Acta Adriatica; Annual Report.—*Cf.* VAUGHAN 1937.

*Struga:* **Die Hydrobiologische Abteilung der Antimalariastation zu Struga:**—*Cf.* LENZ 1927.

*Crna Mlaka* (Zdenčina, Kroatien): **Teichwirtschaftliche Versuchsstation:**—*Cf.* LENZ 1927.

After this booklet had been completed I received word of the publication of an extensive biography of ANTON DOHRN *by* THEODOR HEUSS (Berlin und Zürich: Atlantis-Verlag, pp. 319, 1940).—This is a very fine volume, of great interest to all interested in the development and methods of organization of biological stations.

# CHRONICA BOTANICA
# CALENDAR

# MCMXLV

*O bone Deus! Dum aspicio fata botanicorum, an sanos vel insanos in plantas eos dicam, haereo profecto* (LINN., Critic. botan., no. 238).

## *Contents:*---

**Curtis's Botanic Gardens:** PLATE 9 shows a reproduction of a water-colour drawing, by JAMES SOWERBY (1757-1822) of WILLIAM CURTIS'S botanic garden at Lambeth, *ante* 1787, which was at some time in the collection of GORDON DUNTHORNE, Esq. (*cf.* the catalogue of the Dunthorne collection in the "Old Print Shop Portfolio"; New York City, Vol. 2, No. 12, Aug. 1943). It is of great interest as the only known picture of the garden and as one of SOWERBY'S rare landscape studies, the famous botanical artist lived quite near at 2 and 3, Mead-place, afterwards 63, Westminster Bridge-road.

In 1771 CURTIS took about an acre of land in Bermondsey for the cultivation of British plants, the site is about the present Crimscott-street, Grange-road.

About the autumn of 1777 (NICHOLS, History of Lambeth, 1786, p. 84) CURTIS started to lay out a new garden, part of Restoration Spring Garden, plainly marked on JOHN ROCQUE'S map as abutting on the western side of Angel-street (continuation of Broad Wall) southern end. In 1778 he published his "Proposals for Opening the London Botanic Garden" described as "situated very near the Magdalen Hospital, in the road from the Hospital to Westminster Bridge turnpike, through the village of Lambeth Marsh". The district had been for two centuries a favourite resort of Londoners and was celebrated for its flowers and medicinal herbs, GERARD collected the water-violet here.

Many plants were sent to the new garden by the King, Sir JOSEPH BANKS and many others and it was opened on 1 January 1779. There was more space for classification than in Bermondsey and its low situation made it very suitable for aquatic and bog plants. CURTIS'S "Halfpenny Hatch" or toll-gate was a passage across St. George's-fields from Narrow Wall, opposite Somerset House. But smoke and increased rent made a move necessary and in 1789 a new garden was started at Queen's-Elm, Brompton.

A plan of this is in W. HUGH CURTIS'S "William Curtis" (p. 85). Tab. 114 (March 1, 1790) of the "Botanical Magazine" is inscribed "Botanic Garden, Lambeth Marsh" and tab. 115 (April 1, 1790) "St. George's Crescent". While at Lambeth Marsh CURTIS also had a garden at Charlton, Kent.

WILLIAM SALISBURY, CURTIS'S pupil (1792) and partner (1798) carried on the garden after CURTIS'S death (1799), and in 1808, the lease being nearly expired, removed the garden to the site of Cadogan-place. A description and plan by SALISBURY is in the Gentleman's Magazine 1810, ii, 113-114 and in his "Botanist's Companion" I (1816). SALISBURY died in 1823.

On the S. E. corner of the Brompton site the first stone was laid of the Hospital for Consumption on 11 July 1844. The Cadogan-place garden gradually degenerated, finally becoming a nursery, arboretum, and subscription garden. (JOHN ARDAGH, A.L.S., British Museum of Natural History, *London*).

# THE ECONOMIC STRUCTURE OF THE POST-WAR WORLD*

*by*

HENRY C. *and* ANNE DEWEES TAYLOR

THE social structure is composed of all those institutions and agencies, public and private, which service and control the people of a geographic area or a sphere of interest. The world social structure is as yet but fragmentary. International law, international agreements, and the international agencies, private and governmental, carrying on or facilitating world trade are the important beginnings of what may become an effective world social structure. The International Institute of Agriculture, the World Court, and the League of Nations represent efforts to develop world institutions which may help to integrate a world social structure.

There is great need and, at present, great hope that in the post-war period the world social structure will be developed in a manner greatly to facilitate international relations of a political, economic, and social nature. This is necessary if world peace is to be realized.

The commerce of the world can best serve all the peoples of the world only when the world social structure has been developed to the point where the actions of any one nation will not run counter to the best interests of the world as a whole. Just as the professional groups, the industrial groups, the labor groups, or the agricultural groups within the nation should have autonomy so long as they keep within limits which promote the general welfare so, under the controls of the world social structure, each nation should be free to run its affairs as it likes so long as it keeps in harmony with world welfare.

To perfect this world social structure it is essential that men have the will to create conditions under which each nation may develop along the lines of its own resources and abilities. With the best of world statesmanship the building of an effective world social structure to serve the interests of all mankind will take time, patience, and great skill. It will require not only enlightened attitudes on the part of each nation but also a fundamental international understanding and genuine coöperative action on a world basis.

**International Trade Policies:** — The view is held by many people in many nations that the major international conflicts and wars arise out of economic maladjustments resulting from the use by nations of artificial barriers to the international free flow of labor, capital, and goods. At a World Economic Conference at the League of Nations in 1927 the view was

* This article is an adaptation of Chapter 16 of *World Trade in Agricultural Products by* HENRY C. and ANNE DEWEES TAYLOR, The Macmillan Company, New York, 1943.

expressed that obstacles should be removed "with the two-fold object of stimulating production and restoring free channels of trade". This, it was said, "requires concerted international action", specifically that it is essential "that nations should take steps forthwith to reverse or diminish those tariff barriers that gravely hamper trade".

Another version of this point of view emphasizing the relation of trade barriers to international peace has been expressed in the following terms: The greater the economic significance of political frontiers, the greater the danger of war; and the greater the facility with which all nations may secure through commerce the basic necessities of national life, the greater the prospects of peace.

But there are those who have serious doubts as to whether the free flow of labor, capital, and goods would of itself guarantee peace and prosperity for the people of the world. They doubt whether under a policy of complete freedom of trade, the less advanced countries could make the desired progress in the development of manufacture. They fear that with some nations of the world highly developed industrially and commercially and other nations as yet largely in the agricultural stage, the powerful industrial nations will be in a position to exercise excessive economic and political control over the so-called "backward nations" in a way that might retard industrial development and cause serious conflicts to arise.

From this point of view Professor S. N. PROKOPOVICZ has made the following statement:

> These are the economic causes of the war between Germany and Russia. Russia, rich in raw-materials but a backward country as regards industry and having paid dearly for this backwardness, began in 1890 to build up this industry energetically, to increase the population of her towns and to lift her material and intellectual culture to a higher level. In doing this, Russia, the former "granary of Europe", like other agrarian countries which began energetically to develop their national industry, came into conflict with the interests of old advanced industrial countries, which acutely needed raw-materials and markets for the outlets of their products. This industrialization provoked a particularly hostile attitude in Russia's nearest neighbor, Germany, which had developed her own industry to a considerable extent on the basis of Russian raw-materials and of a Russian market, and which, faced by the possibility of losing both, became vitally interested in the destruction of Russian industry and in the extension of territory towards the east and the southeast at the expense of the lands of the Czechs, Poles and Ukrainians. These directly opposed economic interests were inevitably bound to lead to a political collision and to war.[1]

Japan wanted southeastern Asia to serve as the basis of its industrial and commercial expansion. A serious conflict between China and Japan began when China refused passively to submit to the Japanese industrial and commercial policies and began to boycott Japanese goods. While visiting Japan in 1932 the senior author was told by a former student of his, who was then a professor in one of the imperial universities, that Japan wanted to do for the Orient what England had done for the Occident by becoming the industrial and commercial leader in modernizing the economic life of eastern Asia.

[1] S. N. PROKOPOVICZ, Editor, *Quarterly Bulletin of Soviet-Russian Economics* (Geneva, Switzerland). "The Economic Causes of Russian-German War", p. 30, *Quarterly Bulletin of Soviet-Russian Economics*, No. 9-10, Nov., 1941.

**Economic Imperialism:** — The ambitions of Germany and Japan to establish industrial-commercial empires over vast agricultural countries outside their own political borders have been powerful influences leading to conflicts which are absorbing the energies of the world.

It is well recognized that Germany and Japan are not the only countries that have developed geographical concentration of industry and commerce dependent upon trade with the agricultural areas of the world. The Industrial Revolution of the 18th century created in England the first great workshops of the world, which exchanged their manufactures for the products of the soil of more and more distant lands. England provided itself with a diversity of agricultural products by taking advantage of the climates and soils of other parts of the world, and also augmented the domestic supply by drawing food and raw materials from the more thinly populated countries of the new world, and thus played a leading role in giving world trade in the nineteenth century its tremendous expansion.

England has provided the student of economic and commercial history the classic examples of industrial and commercial imperialization, but its trade was in a large measure with the then recently colonized areas of the world and during the early colonial period the system was advantageous to the new countries because it enabled them to devote themselves to the development of rich natural resources. By the time Germany and Japan entered the commercial world as modern industrial nations, the colonization of the world had been practically completed and the time was already approaching for a change in the economic policies of England.

As early as 1900 there were those in England who recognized the forces at work which were tending to undermine the basis of England's industrial and commercial supremacy. In a lecture at the London School of Economics in December, 1899, Professor W. A. S. HEWINS, Director of the School, pointed out that Great Britain's large population and high living standards were possible only because of its industry and foreign commerce. He pointed out two dangers: first, the newer areas of the world which had found it profitable first to exploit raw materials and later to develop one and then another processing industry, might continue to develop their factories until they would no longer need to send agricultural products to England in exchange for manufactured goods, which, he said, would not only result in a decline in the commerce but also in the industry of Great Britain; second, other countries, such as Germany, were competing more and more successfully in world commerce and were taking a share of that which otherwise might be available for the British.

Does the development of industrial and commercial empires competing for food, raw materials, and markets, necessarily result in conflicts among these empires and between them and the countries from which they wish to draw food and raw materials and in which they wish to sell their products? Or can there be developed, in the face of manifest differences in efficiency and resources, a collective assurance that all the peoples of the world may have opportunities and rewards comparable to their skills and efforts without fear of exploitation or oppression? The answers to these questions will depend on the kind of world social structure the people have the wisdom, the will, and the skill to build.

**What Next?:** — Will the conditions of peace at the close of the war be such as to make it desirable and possible to restore the world rubber market to the producers of southeastern Asia, or instead of depending upon this potentially perpetual source of supply, will it be thought more desirable to look to other sources? In considering this question, full account will be taken of the potential sources of natural rubber in tropical America. Steps have already been taken by the Americas to stimulate the cultivated rubber industry in the tropics of the Western Hemisphere, where leaf disease and inadequate labor supplies have been major obstacles to its growth. It is to be hoped that a long-time point of view will be taken, that the welfare of all the peoples involved will be considered and that any permanent shift from perpetual sources to temporary sources of rubber will be studied from every angle. For example, will it be good policy to depend upon the exhaustible petroleum resources for the manufacture of artificial rubber instead of using the potentially perpetual functioning of rubber trees? Other agricultural sources of rubber, direct or indirect, will, of course, be considered. If an artificial rubber is developed that can replace crude rubber wholly or in part as a raw material for tires, and which is comparable in price, growers of rubber may expect a diminished share in the world rubber market.

Similar questions arise with regard to silk. Will there again be an extensive world trade in raw silk? Will synthetic products continue to supplement or will they largely supplant silk?

Although corn increasingly dominated world trade in feed grains from 1924 to 1938, a new pattern may be drawn during or after the present war. Will the lack of a market for corn during the war bring a permanent change in the organization of the agriculture and the livestock industry in the Argentine? If the Argentineans should successfully transform their corn crop into high-class bacon and hams for the world market or for the enlarged population of an industrialized Argentina, would the place of corn in world trade lose its prominence compared with the place of other feed grains in world trade, or would exports of corn from other countries take the place of Argentine corn in the European market? Or, again, would there be a European market for corn? Feed is one of the lowest priced products in relation to volume and weight. Therefore, it was one of the first items to be reduced in shipping — and will be one of the last to regain a place. Will there be permanent adjustments along this line?

What will be the rôle of technical progress in agriculture, industry, and transportation in determining world trade in agricultural products? How important a rôle has world trade in agricultural products played in making possible the high standards of living of the people of northwestern Europe and the United States? Can these benefits be extended to the so-called "backward nations"? Do conflicts arise when outside capital undertakes the development of relatively undeveloped territory? Are skills, intellectual leadership, and organizing ability from "advanced nations" to be exported to "backward nations"? Is world uniformity in economic institutions to be desired?

Is it probable that the world social structure of the afterwar period will provide for the continuation of geographical concentration of industry

in a few nations dependent upon many other nations for markets, as well as for food and the raw materials of industry? Is it probable that many nations will be willing to serve as agricultural "hinterlands", and if so, can they, in this capacity, maintain their independence either economically or politically?

**New Patterns:** — It is not to be expected that the pattern of world commerce in agricultural products can be or should be the same after the war as before. The character of the pattern will be influenced by the extent to which world commerce continues to be dominated by the highly industrialized nations and by the extent to which the agricultural surplus countries develop their own industries and by the extent to which the one-hundred million farmers, or more, who have continued to produce primarily for home use, expand production for the world market.

A major change in world trade in agricultural products would result if each of the agricultural nations developed the processing and manufacturing industries in proportion to their agriculture. For example, the U.S.S.R. once called the granary of Europe, ceased to play an important rôle in world trade in agricultural products. Of course, the extent and character of the industrialization of a given agricultural nation will be influenced by the abundance or scarcity of all the natural resources including the metals and mineral fuels, and by the characteristics of the population and the availability of capital.

While the industrialization of the nations which are now exporting agricultural products in exchange for manufactured products would tend to reduce the amount of world trade in agricultural products, it might not affect the exchange of agricultural products for mineral products or the exchange of agricultural products between different climates, in fact a change of this kind might well be accompanied by an increase in the international exchange of agricultural products due to the modernizing of the agriculture and the industry of countries like India and China. Farmers in these countries would then more generally produce surpluses of the things they can produce to the best advantage to exchange for agricultural products grown in other climates and thus expand that part of world trade in agricultural products which arises out of variations in physical geography. The possibility for expansion of world trade in this direction is very great. A prerequisite, of course, is stable governments which are able to protect life and property and enforce contracts.

Furthermore, there is a growing realization that even in the period of greatest world prosperity a large proportion of the population of the world was undernourished. Nutritional studies are promoting the idea of greater use of the so-called "protective foods". Progress in meeting these needs may wield a great influence on trade in food commodities.

Production primarily for the market characterizes the activity of fewer than one-sixth of the farmers of the world. A high proportion of the farmers of Europe, North America, and the South Temperate Zone produce primarily for the market. The farmers of the rural villages of eastern and southeastern Asia as a rule practice the self-sufficing economy. The farmers of the Orient produce but little for the market and buy but little in the

*market. The disadvantage of this* self-sufficing economy is the fact that *people have rarely, if ever, found it possible* to attain a high economic standard of living on the basis of the limited variety of products available in any one locality. The low levels of living in the rural villages of India and China where commercial agriculture is but little developed give abundant evidence of the limitations set by the practice of local self-sufficiency.

**The Self-Sufficing and the Commercial Economy:** — "Self-sufficing agriculture" and "commercial agriculture" are not mutually exclusive. In this article, when we speak of a self-sufficing agriculture, we mean that the production is primarily for use in the home of the farmer or his landlord and that production for the market is of small importance. By commercial agriculture we mean production for the market as the major undertaking of the farmer with the understanding that he normally will be producing a great variety of products for home use.

We know of no place where the self-sufficing economy is carried so far that the farmer sells absolutely nothing. On the other hand, few farmers in the western world produce absolutely nothing for home use. These two economies are combined in different proportions in different countries and in different parts of the same country and even on neighboring farms.

The relatively high level of living of the people on the family farms of the western world is based upon a combination of commercial agriculture and production for home use. The overemphasis of either is to be avoided. The farmer who gives primary attention to producing for home use will usually lack the funds for providing his children with a higher education. The farmer who overlooks the importance of producing for home use finds himself likewise limited because of the high cash outlay for food, much of which might be of better quality if produced at home. While farmers in the United States have the reputation of possessing a high standard of living, there are important exceptions. In fact the lowest standards of living in rural America are not to be found on the Southern Appalachian Highlands where the self-sufficing economy is dominant but in the areas of cotton production where a high proportion of the farmers grow cotton for the market and produce almost nothing in the way of fruits, vegetables, bread grains, feed crops, dairy and poultry products, and meat for home use.

In considering the modernizing of the agriculture of the so-called "backward nations", full attention should be given to securing that combination of commercial and self-sufficing agriculture which will, in the long run, provide the best life for the people. This point cannot be too strongly urged.

**To Endure:** — While commercial agriculture, added to production for home use, may be a means of building a civilization with more of the physical comforts and opportunities of education and culture, the question may be raised as to which type of rural civilization, the highly commercial or the largely self-sufficing, can the better endure the privations and disasters of centuries of international conflict. Clearly, the commercial nation with its great industries and its agricultural production for the market can build

fighting equipment of a kind that the self-sufficing economy cannot produce. On the other hand, the highly complex commercial economy is vulnerable at many points. Without its key centers, without its transportation system, the national life is paralyzed; the control of these may put the enemy in control of the nation.

Not so where the civilization is based on a local economy in which people can live without great centers of commerce and without a transportation system. When it comes to perpetuating the race in a period of continued world upheaval, is it not possible that the self-sufficing farmers of southeast Asia will provide the seed for repopulating the earth if Western civilization should destroy itself with the machinery it has had the skill to construct, but lacked the wisdom and the will to control?

**Life Itself:** — In the light of this problem of maintaining the race itself, should we not give first attention to the development of a world social-economic structure that will provide the conditions of world peace? Once there is assurance of responsible governments in a peaceful world, it may take little outside effort to modernize the agriculture and industry of countries which have for thousands of years followed the instincts for self-preservation by continuing to depend upon their self-sufficing economy and by avoiding dependence upon distant markets.

In modernizing the agriculture and industry of these countries it is of vital importance that the desires of the peoples for higher levels of living, including educational and cultural elements as well as greater material comforts and satisfactions, be the driving force that brings about the change. There is the danger that superimposed improvements in agriculture may result simply in a rapid expansion of the population without improving the quality of the civilization. Unless these improvements in agriculture are the result of, or at least associated with, an inner urge for a higher level of living in terms of food, clothing, educational facilities, and cultural opportunities, the population will continue to "press upon the food supply" on the basis of the old standard of life. Professor RICHARD T. ELY says, "The number and character of the wants which a man considers more important than marriage and family constitute his 'standard of life' ". But when improvements in agriculture and industry are the result of an inner urge for a higher level of living the people are on the high road of modern civilization.

The urge for a higher level of living is in evidence in many lands. The Latin American countries and China are showing particular evidence of seeking higher levels of living through modernizing their agriculture and developing their manufactures. Will this modernizing take place? If so, how rapidly? The speed depends upon the methods used. If it is left to local private initiative and to domestic capital, the development may be slow. If foreign management, skill, and capital are encouraged to participate, the growth of industry may be more rapid and if the agricultural nations decide to use the power of the state in financing and otherwise stimulating the growth of industry, the progress may be rapid as has been demonstrated by Russia.

The United States industrialized rapidly in the half century between the

Civil War and World War I. In what measure do conditions such as existed in America from 1865 to 1914 exist in the Latin American countries and in the Orient? If there is land available, the modernizing of the agriculture may readily take place if the people have the desire, the skill, and the knowledge, and if the governments are stable and beneficent, and if transportation systems and markets are developed.

In parts of Latin America the agriculture has long been on a commercial basis but dependent upon a foreign market and upon foreign industrial products. Here other conditions being favorable, industrialization may progress rapidly. But much of the agriculture of Latin America is of a primitive self-sufficing nature carried on by a people little advanced in the arts and culture of modern civilization. Here the modernizing of agriculture and the industrialization of the economy can progress but slowly.

In China there are said to be large tracts of land capable of successful and profitable utilization for commercial agriculture which are not fruitful enough to support the self-sufficing economy. Some Chinese economists believe the movement of farmers into these areas simultaneously with a rapid development of industries and the expansion of the industrial population may provide the opportunity for commercializing the agriculture and enlarging the area per farm in the densely populated agricultural areas.

The history of Manchuria throws some light on the possibility of expanding commercial agriculture into areas not suited to the intensive types of the self-sufficing economy. Manchuria was sparsely populated until railways were put through the country and the commercial side of agriculture was encouraged, then Chinese farmers moved rapidly into Manchuria. The products shipped out — largely soybeans — provided the means of buying the things needed to supplement production for home use. Without these outside products the population could not live by farming solely for home consumption — the variety of local products was too limited and the climate was too severe. But once commercial agriculture was made possible by transportation and markets farming became profitable.

It has been emphasized by Chinese economists that the utilization of unoccupied land and the development of industry must move rapidly if it is to relieve the population pressure enough to provide opportunity for the modernizing and commercializing of the agriculture of the densely settled areas of China. The experience of India and Japan tend to confirm this view.

The people of the agricultural countries want industries not only because they want higher levels of living, but because they want to be free from the domination of industrial nations. They recognize that war strength no longer depends primarily upon the numbers of men of fighting age in the nation but very largely upon the ability of a nation to produce specialized war equipment. The industrial nations have the capital and the skills to produce tanks and planes. The agricultural nations are without the means of producing modern war equipment. The leaders of an agricultural nation cannot face these facts without giving thought to the means of insuring national security.

But there is an aspect of this question to be considered other than the added war strength and higher level of living gained by an agricultural

nation when it acquires a pro rata share of the world's industry. If all agricultural nations become industrialized, industrial nations would have to possess agriculture in proportion to industry. This will mean the decline of industry in those nations which have developed their industrial populations far beyond what their agriculture can provide with food and raw material. This decline of industry will weaken certain dominant nations at the same time that the weaker nations are gaining strength.

This foreshadows serious and highly complex problems for those nations whose economy is geared to the outward flow of manufactured or processed goods or of mineral products and the inward flow of the products of agriculture. Will they return to a more even balance between their industry and their agriculture? Will they reduce their industrial populations to correspond to the growing industrial populations in the agricultural nations? Will this result in the migration of skilled workmen to countries that are in the process of industrialization? Will political considerations and ambitions promote or impede such a reorganization in the economic structure of the world?

The character of the response of the more powerful nations to these questions in the post-war period will determine in large measure the character of the future world social structure and the prospects for world peace.

# Plant Science Forum

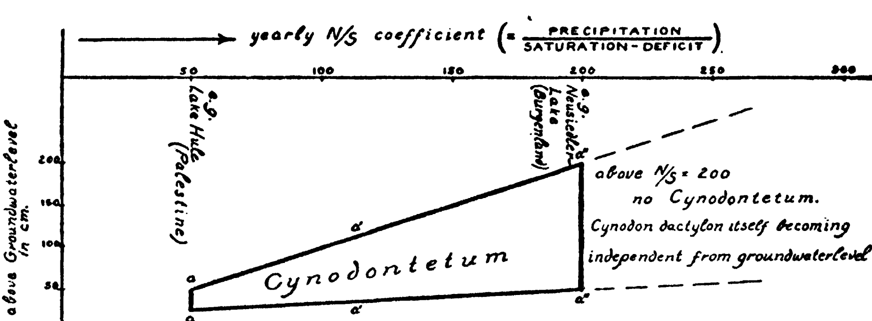
Hugo Boyko: **On the Need for an International Network of Plant-Sociological Stations*:** — The great progress of plant sociology in the past two decades has — in spite of the brief period of this development — already contributed much to an increase in the possibilities of production (in forestry, range management, etc.). The understanding of indicators in natural vegetation is, in particular, ready to become an integral means of increasing production.

In this connection, however, difficulty often arises from the fact that the majority of indicators — be they species or entire communities — possess only a restricted, at best a regional significance. This is even true if the geographical distribution of the indicators in question is very widespread.

Their ecological relationship often changes very considerably with geographical position, and actually also with respect to one and the same factor, not merely in those more extreme cases, which we designate as "Factor-Substitution." Moreover, we have in this phenomenon often only a shift in amplitudes.

The latest researches now show that these "geo-ecological amplitude shifts" involve definite regularities, and that they may be determined *quantitatively* through a suitably spaced network of observations.

We offer here an example, briefly and without going into details. The illustration is taken from the author's planned "Handbook of Applied Plant Sociology".




The relation of the *Cynodontetum* to ground water level (and to lowering of ground water) in semi-arid and arid climatic regions has been investigated by the author in several parts of Europe and the Orient. It is evident that mathematically determinable principles underlie the amplitude changes involved. In other words, it is possible in this way to establish biological standards of general significance. In this instance it means that we can, in such regions, readily determine any of the three magnitudes (*1*) N/S quotient,[1] (*2*) groundwater depth, (*3*) vertical expanse of the *Cyno-*

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* The author gratefully acknowledges the help and advice he has received during the past few years from Dr. Paul B. Sears (Oberlin College) who also undertook the translation of this proposal. — The Editor of *Chronica Botanica* will be glad to give space to further discussions of the proposed international scheme.

[1] *i.e.*, Precipitation/Saturation-Deficit.

*dontetum* zone, if we know the other two; indeed in the case of No. 3, if only this one magnitude is known.

This one example[1] may suffice here, where only the principle involved needs to be shown. In order safely to test, establish and evaluate "biological standards" of this sort in their entire broad application, the determinations of a single observer are not enough. For that purpose a *network of plant sociological stations* is necessary, which can be charged with such responsibility from an international center.

The determination and establishment of biological standards is only one of many results of practical value which such an organization might have for science and husbandry. We have only chosen this example in order to emphasize with a concrete instance the necessity of an international arrangement for observation. Just now the thought of plant husbandry on a world scale is beginning to be an object of discussion among leading statesmen. We must see to it that scientific wisdom is here added to political. Statements such as those of VERDOORN which so forcefully discuss the "scientists' fiasco" apropos of the outbreak of war are still too few (CHRON. BOT. V:325). They ought not to be read repeatedly but ought to be spread from all educational pulpits with apostolic zeal.

Today we face the end of the war. It is now for us scientists to make possible the execution of far-reaching ideas of this kind. Only with the aid of science can those gulfs between peoples be lessened which are a constant threat of ever more fearful wars.

In general, statesmen see the gradual removal of these gulfs by a just divisions of *products*. However, we see that the just and rational allotment of *production* is necessary to the improvement of welfare and — this is most important — to harmony among nations.

Here we have a result of applied plant sociology, which reaches deep into the sociological structure of mankind and which can be accompanied by far-reaching results. The valuation and classification of regions on a basis of the most trustworthy index, their natural vegetation, with world standards from a suitable network of plant sociological stations, is one service which science can render to the statesmen. And it is not the least significant.

It should be noted in passing that through such an international organization the opportunity might also be given to bring differing methods into harmony. In any case the author sees no difficulty in setting up the problem and evaluating it.

Somewhat more complicated, it seems to him, is the practical completion of such an organization. The concrete problems which occur to the author must be tested and formulated from a widely, but not too widely, authoritative center by which they may be submitted to the international botanical, or scientific world.

In order to get the practical course of the project going, a central estab-

[1] The above example is also of interest in connection with the controversy between BRAUN-BLANQUET and GAMS with reference to the *Cynodontetum* (*cf.* CHRON. 5:393). It seems to the author that in BRAUN-BLANQUET's concept the ruderal character of *Cynodon* in C., W. and SW. Europe is primarily taken into account, whereas GAMS considers especially the very characteristic *Cynodontetum* association in low, humid places in the semi-arid E. European steppes.

lishment, preferably CHRONICA BOTANICA, ought to invite such a committee of about the following composition:

(*a*) the president of the Ecological Society of America or a representative of the Society, designated by the presiding authority;

(*b*) the chairman of the Committee on Symposia of this Society or a representative of this committee experienced in the organization of symposia;

(*c*) the editor of CHRONICA BOTANICA as a representative of this generally known international forum.

These three prominent representatives from one country would form a compact executive committee so that minor decisions would not have to be delayed by months-long correspondence.

(*d*) As representative for the region of the British Empire, the president of the Ecological Society of Great Britain or one or two representatives of the Society designated by the presiding authority.

(*e*) One or two from similar bodies, such as representatives to be designated by the Soviet Academy of Science, for the region of East Europe, Central Asia, etc.

(*f*) Likewise a representative of north Europe, to be designated by the Swedish Academy of Science, as well as a representative of their existing (botanical) Congress Committee.

(*g*) Likewise a representative of the two great geobotanical institutes in Montpellier and Zurich which at the same time would represent the Mediterranean and South European or the Central European region. (After the end of the war, the committee could be enlarged.)

(*h*) For more detailed and further procedures, the proponent would hold himself responsible. At the same time, the region of the Near and Middle East could be taken care of.

The right of co-option should remain to the executive committee. The committee ought to place a program before the next International Botanical Congress. In this way the great organizations and stations which already concern themselves with these problems could be combined, and the important regions of the earth encompassed with a network of already-existing scientific institutions. By this plan a beginning would be made which would draw together other purely botanical scientific activities in collaboration.

(*1*) How far after the organization of this committee activities can be completed and brought to a fruitful coöperation, (*2*) how extensively it can be modified for this object, and (*3*) how new undertakings can be planned, must await developments. The course which the committee will have to follow in the beginning will be chiefly of an organizational character. This is true even though already formulated problems are considered for international collaboration.

In any case, it seems not impossible to the author that such an organization can develop in a substantial way in various directions: as an example, in a narrow field of work, what modern science as a whole ought to attempt, a symposium on a world scale.

HERBARIUM BOYKO,
JERUSALEM-TALPIOTH,
PALESTINE.

EDGAR ANDERSON: **What is Zea Mays? — A Report of Progress:** — The work of MANGELSDORF and REEVES (1) led me to look into the phenomenon known as *Zea Mays*. It was almost immediately apparent that, considered in its entirety, this remarkable assemblage of forms was prac-

tically unknown. I therefore set myself the task of studying what might be termed "the physical anthropology of the maize plant". A preliminary discussion of the problem of describing and classifying maize was published in 1941 (2). By this time it was apparent that in the fields of anthropology, archaeology, and geography there was much valuable information about maize which needed to be integrated with more purely botanical and agronomic information. A Guggenheim fellowship allowed me to work with such scholars as Professor CARL SAUER of the Department of Geography of the University of California and Dr. ISABEL KELLY, the leading authority on the archaeology of western Mexico.

As a result of this activity a number of seemingly unrelated facts in the fields of anthropology, geography, agronomy, history, genetics, and taxonomy are being brought together and published. This short summary will serve to sketch in the problem as a whole and to summarize the published results. It is well known that *Zea Mays* is for purely technical reasons pre-eminent in cytological and genetical studies. For purely technical reasons it is also superb archaeologically. It leaves a more detailed record behind in dried and charred material than any other crop plant (for example, an ear of corn tells us much more about the plant than a pod of beans or a tomato seed). Its historical record is also unusually rich as compared to that of other crops. When information from these various fields is merged we shall have a more complete understanding of the origin and development of *Zea Mays* than will ever be possible for any other domesticated plant or animal.

The chief results of the first five years may be summarized under three headings:

I. What is *Zea Mays?* This specific name covers a multitude of races and varieties. A few of these have now been fairly exactly described: *a*) The remarkable sweet corns discovered in western Mexico by Dr. ISABEL KELLY (3) ; *b*) The popcorns ("maíz reventador") from the same area (4) ; *c*) The old Spanish *"maiz del país"* of California (5) ; *d*) A peculiar popcorn of salty oases in Chile and Peru discovered by Professor SAUER (6) ; *e*) A wonderfully preserved sample of prehistoric maize from the southwest (7). Reports of the two main races of the American Southwest (Pima-Papago and Pueblo) are now in preparation as well as a general account of the maize of Mexico. Technical descriptions of ethnological and archaeological material have been prepared for Professor RALPH BEALS, Dr. EMIL HAURY, and Dr. ISABEL KELLY and will eventually appear as appendices to their final reports. A general account has been published for Spanish-American archaeologists (8) as well as a detailed description of prehistoric male inflorescences (9).

II. What is the origin of *Zea Mays?* The whole program outlined above was undertaken in protest against discussion of the origin of a virtually unknown plant. It seemed to me that one should acquire at least a rough notion of what *Zea Mays* as a whole was like before wasting any serious thought on how such a group of plants might have originated. I still feel that the time is not yet ripe for a serious study of the problem. However, certain facts have emerged which enlarge the possibilities to be seriously considered. (Parenthetically it may be stated that nothing has been found

which disagrees with MANGELSDORF and REEVE's (1) theory that *Euchlaena* is an artifact and is not an ancestor of *Zea*. No conclusive evidence for their hypothesis has been found but rather a whole group of facts which are difficult to explain on any other hypothesis, as for instance the distribution, morphology and the cytology of *maiz reventador*.) As to *Zea Mays* itself, Professor SAUER's collections from South America have led me to consider seriously an ancient Asiatic origin and an early trans-Pacific migration along with cotton, pottery, weaving, etc. (6). Here again there is no conclusive evidence but a number of different sources indicate Upper Burma as a possible center of origin from whence maize might have spread to the west coast of the New World via Java, Timor, etc. Some of the straws which point in this direction may be listed:

*1.* Resemblance of Rio Loa popcorn to Upper Burmese corn (6).
*2.* Uses of popcorn by primitive peoples in Java, Timor, etc. (12,13).
*3.* Recent work by several laboratories on the origin of amphidiploid cottons.
*4.* Stratigraphic excavations in Chile by Dr. JUNIUS BIRD (14).
*5.* General resemblances of early Nazca and Paracas pottery and fabrics to oriental types. In particular the presence of pottery pipes-of-Pan, delicate weighing balances, complicated weaving techniques, etc.
*6.* Wide occurrence of dominant gene for blue eggs among a strange variety of domestic fowl at high altitudes in the New World (15).
*7.* Presence of a group of genera related to *Zea* with chromosome numbers of 5 and 10 in the Burma, India, South China region. All of these plants were primitive forage or grain plants (10).
*8.* Presence of burn-down-the-forests-and-plant-a-group-of-crops-in-the-ashes-agriculture in Upper Burma as well as in the New World (11).
*9.* Presence of peculiar strains of maize in Upper Burma which are grown by primitive mountain tribes (16).
*10.* Documentary evidence that maize appeared around Shanghai in the early part of the sixteenth century and had been introduced from the Burmese or Tibetan border (17, 22).
*11.* Extreme diversity of maize in Upper India (18).

Much of this evidence is rather trivial. Taken in its entirety it is most suggestive and before we can study the problem seriously we must have careful collections of native varieties of *Zea Mays* throughout the orient. For the present we should merely remember, *as one possible hypothesis*, that *Zea Mays* may be an amphidiploid derivative of something like a 5 chromosomed *Sorghum* crossed with some 5 chromosomed relative of *Coix* which spread from Asia to the New World in pre-Colombian times, that it there gave rise to *Euchlaena* by hybridization with *Tripsacum*. Subsequent hybridization with *Euchlaena* introduced *Tripsacum* germplasm into *Zea* and produced the wide assemblage of forms which we find in the New World.

It should be pointed out that if there is a possibility of pre-Conquest transfer across the Pacific it will take exceedingly critical collections in the Orient to decide between the following three possibilities: (*1*) Oriental origin with post-Conquest re-introduction of New World types (*2*) New World origin with pre-Conquest introduction of primitive types and post-Conquest introduction of advanced types (*3*) New World origin with nothing but post-Conquest introductions in the Orient.

III. What is the agronomic importance of understanding *Zea Mays* as a whole? It now seems probable that an understanding of *Zea Mays* in

space and in time may be of practical value in modern maize breeding. This general question is being investigated in conjunction with Mr. RAYMOND BAKER, chief of the breeding department of the Pioneer Hi-Bred Corn Company (20, 21). On purely theoretical grounds it might be expected (19) that genes which went into modern maize together might tend to stay together, even in corn-belt varieties. This is apparently true to such an extent that knowledge of the general morphology of Mexican and South American races may be very helpful in practical breeding. Such phenomena as the specific combining ability of any two inbreds, the lack of extensive segregation when certain inbreds are crossed, and the mutant types or rogues produced by many inbreds yield encouraging results when studied from this point of view.

My experiences in working at this problem have convinced me of the need for a common meeting ground for agronomists, geneticists, archaeologists, geographers, anthropologists, and taxonomists, as Professor SAUER has been advocating for some years. The results which are being achieved with *Zea Mays* could be paralleled with many of our crop plants. Similar work with tomatoes, squashes, potatoes, and beans is overdue. It may be that a joint committee of the National Research Council could be set up as a meeting ground. On the other hand the pressing importance of many of the problems might indicate an Institute for the Study of Agricultural Origins as a more effective medium. There has been some discussion in the corn state of Iowa, of the possibility of setting up there a comprehensive maize museum, which would serve as a research center and clearing house for correlated studies on that crop. Perhaps with state pride yoked to the cause of science we might hope for a Cotton Museum in Texas, a Bean Museum in California, a Tobacco Museum in North Carolina and smaller federally supported centers for some of the humbler crops. What is badly needed is something which will cut across present budgetary lines and bring specialists in these various fields to work together on their common problems.

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Neeley Turner: **New Organic Insecticides:** — Synthetic organic insecticides have been of increasing importance during the past years. Several materials have been discovered, developed and sold successfully, encouraging an expansion of research in this field. Interest has been stimulated tremendously by the favorable results of preliminary tests of D D T and by the wave of publicity concerning it in the public press.

The new materials recently introduced and used in large quantities include the nitrated compounds such as dinitro-o-cresol and dinitro-o-cyclohexylphenol and their salts, used as ovicides on dormant trees, and to some extent on trees in foliage for control of mites. Phenothiazine (thiodiphenylamine), first proposed as an alternate for lead arsenate, is now a standard anthelmintic for domestic animals. Thiocyanates were in general use in household insect sprays before the war, and have replaced pyrethrum, which is now used exclusively by the armed forces. In addition, beta thiocyano ethyl esters of higher fatty acids have been used in large quantities to supplement low-concentration rotenone-bearing dusts. Recently another thiocyanate, beta betá dithiocyano ethyl ether, has been introduced and sold as a contact insecticide for aphids and leafhoppers.

No development in the whole field of insecticides has been so spectacular as the application of the chemical known as D D T. A small sample sent to this country from Switzerland in 1942 was so successful in controlling lice that domestic manufacture started early in 1943. The effective control of insects that transmit diseases has resulted in a rapidly expanding production now believed to be approximately 2,000,000 pounds a month. Except for a relatively small amount allotted for experimental use, the entire output has been assigned to the armed forces, where it is used for louse and malarial mosquito control.

D D T is the common name given dichloro-diphenyl-trichloroethane (2,2 bis (parachlorophenyl) 1, 1, 1 trichloroethane) (1). First synthesized in Germany in 1874, it was re-discovered during the course of an intensive research project on toxicants initiated by J. R. Geigy, S. A., Basle, Switzerland. Development as an insecticide followed, and in 1939 it was used to save the Swiss potato crop from destruction by the Colorado potato beetle.

The high toxicity of D D T to the body louse encouraged entomologists of the Federal Bureau of Entomology and Plant Quarantine to make preliminary tests on a wide variety of insects. In fact more tests and experiments have been carried out using D D T in the two seasons it has been available than have ever been made with any other material in the same

period of time. Results of the explorations conducted by federal entomologists in 1943 were published in a series of 51 scientific notes (2). Results of the few tests made by other agencies have also been reported (3, 4, 5, 6, 7, 9, 11).

It would serve no useful purpose to list the results of these tests here. They showed that D D T is toxic to a remarkably large number of insect species, and that like all other insecticides it is apparently not toxic to all insects. It is promising for several types of insecticides and for different reasons. For household pests both high toxicity and persistence on sprayed surfaces make it very promising for control of bedbugs, houseflies and ticks. It is of about the same toxicity as rotenone and pyrethrum to many vegetable pests, and is very much less expensive. It does not control the Mexican bean beetle when used at the dosages common to most preliminary tests. It is very promising as a control for the codling moth, certainly the most troublesome pest of apples. It appears to be especially promising for use in controlling forest insects, partly because it can be applied in solution or in suspension and in smokes and aerosols as well as by conventional methods. For control of such potato insects as leafhoppers and tarnished plant bugs it is one of the most effective materials used to date, and in addition affords excellent control for flea beetles and potato beetles.

The preliminary tests show that D D T not only does not kill mites, but that the mite population may rise following applications of the material. Neither the cotton boll weevil nor the plum curculio have been controlled by the percentages used in preliminary tests.

Of particular interest to plant pathologists is the possibility of using D D T to control insect pests that complicate field bio-assay of fungicides. The potato insects mentioned above may be reduced to an innocuous level by D D T which has no direct fungicidal value.

The effect of D D T on such beneficial insects as bees, parasites and predators may have an important bearing on its practical application. It must be remembered, however, that all the insecticides and many of the fungicides in common use also affect beneficial insects.

Toxicity of D D T to higher animals has been studied (8, 10, 12). The material is toxic to both rats and rabbits and in quantities differing little from other economic poisons. Both acute and cumulative toxicity were demonstrated, and the chemical was recovered from brain, liver and kidneys, as well as bile, blood and urine. In solution D D T was absorbed through the skin. Information on its hazards is far from complete. However, SMITH and STOHLMAN (12) have stated: "The toxicity of D D T combined with its cumulative action and absorbability from the skin places a definite health hazard upon its use."

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Agnes Arber: **Sir Joseph Banks and Botany***: — Sir Joseph Banks (1743-1820), whose bicentenary has been commemorated recently (1), stands as a link between the two centuries in which his life was passed. Amongst his countless acquaintances of earlier date were Mrs. Delany, who was born in 1700; Dr. Samuel Johnson, at whose funeral he was a pall-bearer (2); and the naturalist, Thomas Pennant, the correspondent of Gilbert White. On the other hand, amongst the botanical associates of his old age we find such relatively modern names as that of John Lindley, who survived until 1865. Moreover Banks's life overlapped with that of the son of his friend W. J. Hooker — Joseph Dalton Hooker —whose death did not occur until 1911. Banks thus had personal connexions, in the world of science and letters, with people whose lives covered more than the whole range of the eighteenth and nineteenth centuries. His extensive influence upon his own and subsequent periods is reflected in books by a number of authors dealing exclusively or incidentally with various aspects of his activities (3), but a study aiming at completeness, and accurately documented, is still lacking. A large amount of unpublished material at the British Museum (Nat. Hist.), at Kew, and also in Australia and elsewhere, still awaits a thorough overhauling, and when the authorita-

* *Symbolae Phytohistoricae, No. 6.*

(1) See for example Davies, J. D. Griffith (1943): Sir Joseph Banks, P.C., K. C. B. *Nature*, Vol. 151, pp. 180-3.

(2) Boswell, J. (1904): Life of Johnson, Oxford, Vol. 2, p. 648.

(3) The information used in the present essay has been derived from a comparison of the printed sources only; I have not been able to undertake research into the Banksian MSS and collections. In addition to the works mentioned in later footnotes, those upon which I have drawn most freely are Hooker, J. D. (1896): The Journal of the Right Hon. Sir Joseph Banks during Captain Cook's First Voyage in H.M.S. *Endeavour* in 1768-71. London; Jackson, B. D. (1908): Sir Joseph Banks, Dict. Nat. Biog., Vol. I, London; Maiden, J. H. (1909): Sir Joseph Banks: The "Father of Australia." Sidney; Smith, E. (1911): The Life of Sir Joseph Banks. London. Since the present article was in print, a translation of the account by Dr. A. H. Uggla of Jonas Carlsson Dryander (for the Swedish Dictionary of National Biography) has been read before the Linnean Society (March 9, 1944). This paper will appear in Proc. Linn. Soc. Lond., 156th Session. By the courtesy of Mr. Spencer Savage, to whom I also owe other valuable help in preparing this article, I have had the advantage of seeing Dr. Uggla's manuscript. I wish, further, to express my indebtedness to Mr. A. E. Roche, and to the Librarian of the Royal College of Surgeons, for their kindness in answering my enquiries.

tive and large-scale study, which BANKS obviously deserves, comes to be written, the information relating to his letters, which is now being compiled by Mr. J. ARDAGH, of the Department of Botany, British Museum, will be of essential service.

In the present brief sketch we are concerned with BANKS only in his relation to botany, so that the slightest reference to the general facts of his life must suffice. He was born early in 1743 (4). His great-grandfather, grandfather, and father, were all men of consequence and wealth in Lincolnshire, and all three in succession were Members of Parliament. JOSEPH BANKS was educated at Harrow and then at Eton. Sir JOHN BARROW (5) received by word of mouth from Sir EVERARD HOME, who had it direct from BANKS himself, an account of how his interest in plant life was first aroused. It seems that one day he had been bathing in the Thames with his fellow Etonians, but lingered on, enjoying himself in the water, until all his companions had gone, so that his return was a solitary one. He appears to have been a boy who liked the society of his kind, so to be alone in the country was probably a rare experience. It was a fine summer evening, and as, communing with himself, he walked slowly along a green lane bordered with flowers, he suddenly realised that to him it would be more agreeable to learn the names and natures of the plants on which his eyes rested, than the Greek and Latin to which he was confined. He then and there determined to arrive at such knowledge, and he overcame some of his initial difficulties by paying herbwomen to teach him, giving them sixpence for each plant they brought to him. Then, when he returned home for the holidays, he had the delightful surprise of finding, in his mother's dressing-room, a much-worn copy of GERARD's *Herball,* which he took back with him to Eton; while still at school, he began to form an herbarium. JOSEPH BANKS's mother seems to have had much sympathy with his botanical tastes. On his father's death, she moved to Chelsea, which she is said to have selected because of the gardens there, especially that of the Society of Apothecaries, in which her son, then about 18, could pursue his chosen study (6).

From Eton BANKS proceeded to Oxford, where he found that the then Sherardian Professor of Botany, HUMPHREY SIBTHORP, gave no instruction. He approached SIBTHORP, and succeeded in obtaining leave himself to find a botanical teacher, to be paid by those who wished to be taught. It is startling to learn that BROUGHAM, writing more than eighty years after the event, applauded SIBTHORP's concession as "highly creditable to the professor" (7); one wonders what SIBTHORP's, or even BROUGHAM's, reactions would be if they could revisit Oxford, and be made acquainted with the duties of the Professor of Botany as these are understood today. That BANKS

(4) On JOSEPH BANKS's own authority, the date of his birth is stated as Feb. 2, 1743 O. S. *in* BROUGHAM, H. (Lord) (1846): Lives of Men of Letters and Science who flourished in the Time of George III. London, Vol. 2, pp. 338, 9. On the other hand DUNCAN, A. (1821): A Short Account of the Life of Sir JOSEPH BANKS. Edinburgh, gives the date as Dec. 13, 1743; but DUNCAN's memoir is unreliable.

(5) BARROW, J. (Sir) (1849): Sketches of the Royal Society. London, pp. 12, 13.

(6) BARROW, J. (Sir), *l.c.*, pp. 14, 15.

(7) BROUGHAM, H. (Lord), *l.c.*, p. 341.

should have succeeded in inducing SIBTHORP to sanction the arrangement he had planned, shows that, even in youth, he knew how to get his own way, while preserving amicable relations with those whom he dominated. Armed with SIBTHORP's permission, BANKS went to Cambridge, and consulted MARTYN, who held the chair of botany; he recommended a certain ISRAEL LYONS. LYONS was brought to Oxford, and his teaching seems to have been a success.

BANKS's early botanical studies belong to the period when the Linnean system had recently been introduced into England, and this system gave him the necessary mental framework for his detailed knowledge. His ideas did not, however, remain narrowly fixed in that particular mould; late in life he wrote that he fancied JUSSIEU's natural orders to be superior to those of LINNAEUS. BANKS collected with enthusiasm, and his botanical journeys about England recall the earlier plant-hunting excursions of THOMAS JOHNSON, and of JOHN RAY. On one of his expeditions, in 1767, BANKS was accompanied in North Wales by WILLIAM HUDSON. Half a century later, in writing to Sir J. E. SMITH, BANKS says: "Your descriptions, and SOWERBY's drawings, of British plants, would have saved me years of labour, had they then existed. I well remember the publication of HUDSON, which was the first effort of well-directed science, and the eagerness with which I adopted its use." The work in question was HUDSON's *Flora Anglica* (1762), the earliest good British flora on Linnean lines (8). The "eagerness" which always characterised BANKS's pursuit of botany, led him on one occasion, into an absurd predicament. When he was hunting for plants near Hounslow, his erratic behaviour laid him open to suspicion, and he was seized and carried before a magistrate. However, when he was searched, no stolen goods were discovered, but only a quantity of botanical specimens, and he was set free with apologies (9). A man who was with him on an excursion in 1775, speaks of BANKS as travelling in a ponderous coach of his own, in which were stowed "trunks containing voluminous specimens of his *hortus siccus* in whitey-brown paper; and large receptacles for further vegetable materials, which he might accumulate in his locomotions." He goes on to say: "We never saw a tree with an unusual branch, or a strange weed, or anything singular in the vegetable world, but a halt was immediately called, out jumped Sir JOSEPH" (10).

Interested as BANKS was in British plants, his work in this direction was of little importance as compared with his adventurous expeditions to explore other floras. His first opportunity came in 1766, when he was 23. A British ship was being sent to Newfoundland and Labrador on business connected with the fisheries, and he was able to join it for the study of natural history. He made ample preparations at his own expense, and he succeeded in bringing back a good supply of material. BRITTEN (11), who, in

(8) JACKSON, B. D. (1881): Guide to the Literature of Botany. Index Society. Publications, 1880. VIII, p. 233.

(9) EDWARDS, E. (1870): Lives of the Founders of the British Museum. London. Part 2, p. 490.

(10) PEAKE, R. B. (1841): Memoirs of the COLMAN Family. London. Vol. 1, pp. 356, 7. (Quotation from GEORGE COLMAN Junr.)

(11) BRITTEN, J. (1904): BANKS's Newfoundland Plants. Journ Bot., Vol. 42, pp. 84-86.

the twentieth century, estimated the results of this expedition, stated that, besides a large number of specimens of Newfoundland plants, scattered through the National Herbarium, each sheet having notes on the back by BANKS himself, the British Museum (Nat. Hist.) also possesses a list, in his own handwriting, of the plants observed, with localities. This list is probably the earliest in existence for Newfoundland. G. D. EHRET, in the year after the expedition returned, made drawings of more than 20 of BANKS's plants. Another record preserved at the Museum is a transcript by BANKS's sister of his "Journal of a Voyage to Newfoundland & Labrador: commencing April y$^{e}$ seventh and ending November the 17th, 1766." This journal is described as containing much botanical information.

The Newfoundland excursion had confirmed and ripened BANKS's zeal for exploration, and two years later he seized his chance of carrying out such work on a much vaster scale. The Royal Society was concerned with organizing expeditions to observe the transit of Venus of 1769. One ship, the "Endeavour," was to go to the Southern Seas, under the command of Lieutenant JAMES COOK. BANKS was given leave by the Admiralty to join him with a suite of seven, including four draughtsmen, and a Swedish botanist, with whom he had become intimate since his return from Newfoundland—DR. DANIEL SOLANDER—a pupil of LINNAEUS, who did much to promulgate his master's system in England. The "Endeavour" was away from August 1768 to July 1771, and in those three years she circumnavigated the globe. Throughout his life BANKS devoted a large share of his ample private fortune to scientific purposes, and he is said to have spent £10,000 on the preparations for the "Endeavour" expedition. He was not only munificent, but extremely methodical and business-like, so that his arrangements in general worked admirably. He inspired his staff with his own fervour, and his draughtsmen became so used to the sea that on the voyage from Terra del Fuego to Otaheite he could write: "it must blow a gale of wind before they leave off" (12). But in reading the journal which he kept during the voyage, one cannot but be struck, in one instance, by the lack on BANKS's part of those elementary precautions which are held indispensable by modern explorers, who pride themselves on a clean bill of health, and on the fewness of their casualties. When the "Endeavour" was anchored in the Bay of Terra del Fuego, BANKS and SOLANDER, accompanied by ten others, attempted to penetrate inland. They wished to reach the tops of the hills, since BANKS was "infinitely eager" to examine the alpine plants, but they seem to have thought only of an excursion within the day. The plan was ill-organised, and, instead of proceeding straight inland, they walked unintentionally in a semi-circle. Moreover it had apparently not occurred to them to bring any provisions, or any protection against the cold, which was so extreme that, when they were unable to regain the ship that night, two negro servants died of exposure (13). During the rest of the voyage, BANKS's botanical work was achieved without such misfortunes. He not only collected indefatigably, but he took much trouble with the technique of herbarium-making. When the "Endeavour" had reached

(12) HOOKER, J. D., *l.c.*, p. 62.
(13) HOOKER, J. D., *l.c.*, p. 51.

Australia, and was anchored in Botany Bay, BANKS notes, on May 3, 1770, that "Our collection of plants was now grown so immensely large that it was necessary that some extraordinary care should be taken of them, lest they should spoil in the books. I therefore devoted this day to that business, and carried ashore all the drying paper, nearly 200 quires, of which the larger part was full, and spreading them upon a sail in the sun, kept them in this manner exposed the whole day, often turning them, and sometimes turning the quires in which were plants inside out. By this means they came on board at night in very good condition" (14).

It is a curious and regrettable fact that, though BANKS and SOLANDER brought back a superb collection of plants and of drawings, and though time and money was spent lavishly in working up this material and getting plates engraved, they failed to carry their results to the point of publication. It is difficult to account for this. It is true that BANKS had many other competing interests, but SOLANDER, who spent the ten years after the voyage in BANKS's employment, might well have finished the work, but for that temperamental procrastination which seems to have been a recognised feature of his character. It is recorded, for instance, that for several years he neglected to write to his mother in Sweden, and that, at his death after a brief illness, unopened letters from her were found in his room. LINNAEUS, who knew SOLANDER well, was disturbed, to the point of sleeplessness, at hearing of a plan (which did not in fact materialise) according to which BANKS and SOLANDER were to set off in 1772 on a further expedition, before they had worked out their "Endeavour" material. He seems to have realised that, unless SOLANDER could be persuaded to complete the task at once, it would never get done. LINNAEUS wrote to ELLIS that he feared that all BANKS and SOLANDER's "matchless and truly astonishing collection, such as has never been seen before, nor may ever be seen again, is to be put aside untouched, to be thrust into some corner, to become perhaps the prey of insects and of destruction." He adjures his correspondent "to do all that in you lies for the publication of these new acquisitions, that the learned world may not be deprived of them." One cannot but feel that, if BANKS had been urgent in that matter, SOLANDER, who was not only his employee, but also his close friend, could have been induced to see the work to its conclusion; but one of BANKS's distinctive peculiarities was a complete lack of interest in his own reputation as an author—a lack of interest which had one happy result—"entire freedom from all the meaner feelings which mere literary men are but too apt to entertain towards one another" (15). It is true that BANKS was extremely anxious to render his results serviceable to botany, but he seems to have believed that he ensured this, whether be published or not, provided that he made his collections and drawings perfectly accessible to all other workers. He treated his own writings with complete indifference. He handed over his journal of the "Endeavour" voyage to HAWKESWORTH, who, in his account of the expedition (16),

(14) HOOKER, J. D., *l.c.*, p. 267.

(15) BROUGHAM, H. (Lord), *l.c.*, p. 373.

(16) HAWKESWORTH, J. (1773): An Account of the Voyages undertaken by the Order of his present Majesty. Vol. 2. Lieutenant COOK's Voyage round the World. London; see also HOOKER, J. D., *l.c.*

incorporated it almost indistinguishably with COOK's journal and with remarks of his own. HAWKESWORTH himself had not wished to pursue this course, since it meant that "the descriptions and observations of Mr. BANKS would be absorbed without any distinction, in a general narrative given under another name"; but BANKS "generously over-ruled" this objection. BANKS's share in the story has now been disentangled to some extent through the edition of his journal published by J. D. HOOKER in 1896, but even this avowedly contains only about half of what BANKS wrote; moreover it remains a slightly unconvincing document, since HOOKER, who took the liberties that nineteenth-century editors were inclined to allow themselves, states that he "corrected the language." BANKS's aversion from publicity in print revealed itself again, many years after the "Endeavour" voyage, when he handed to W. J. HOOKER a number of papers about Iceland, with the request that, if the contents were used, no reference to his name should be included. HOOKER protested against this anonymity, and with some difficulty extorted permission from BANKS to mention his name where it seemed necessary (17). It is perhaps possible that BANKS had an instinctive feeling that appearances in print were not wholly compatible with the character of a gentleman. The absence of all desire for literary fame may, on the other hand, have arisen in part out of a certain coolness, where personal emotions were concerned. There is a hint of this in the words that, as a young man, he wrote in his journal when he reached Africa on the "Endeavour" voyage: "Today . . . we . . . took leave of Europe for heaven knows how long, perhaps for ever; that thought demands a sigh, a tribute due to the memory of friends left behind, and they have it, but two cannot be spared, 'twould give more pain to the sigher than pleasure to those sighed for." His account, again, of the disastrous excursion into the interior of Terra del Fuego, which we have already noticed, seems to bear witness to the same quality, for he writes that, on regaining the ship, "With what pleasure we congratulated each other on our safety no one can tell who has not been in such circumstances"; whereas one might have supposed that the fact that two of the party had succumbed to their hardships would have made the "pleasure" a mitigated one. This aloofness is perhaps another facet of the personal detachment which made him, when he was in the sixties, and ill-health had come upon him, write that he had had a long and happy life, but that he thought he was "quite willing to resign it."

Though it is tempting to frame speculations as to the causes, external or psychological, which kept BANKS and SOLANDER from completing and publishing their "Endeavour" results, such speculations can never be more than guesswork. In this century we have, however, the solid satisfaction of coming into the possession of at least a considerable sample of their work in printed form, for in 1901-5 a selection of their figures and descriptions was published by the British Museum (18). BRITTEN, who edited the

(17) HERMANNSSON, H. (1928): Sir JOSEPH BANKS and Iceland. Islandica, Vol. 18, Cornell University Library, Ithaca, N. Y., pp. 89 *et seq.*

(18) BANKS, J. and SOLANDER, D. (1901-5): Illustrations of the Botany of Captain COOK's Voyage Round the World in H.M.S. "Endeavour" in 1768-71. Part I. Australian Plants, with determinations by J. BRITTEN. Printed by order of the Trustees of the British Museum. London.

work, arrived at the conclusion—after making a thorough study of the memoranda and manuscripts preserved in the Department of Botany—"that BANKS, who had come to be regarded as a patron of science rather than as a man of scientific attainments, had much more botanical knowledge than was at one time supposed." In conformity with his estimate of BANKS's share in the work, BRITTEN has attributed to BANKS and SOLANDER, jointly, the names of species which have been adopted by various authors from SOLANDER's manuscripts, although formerly SOLANDER alone was given as the authority. As a minor piece of modern work done upon the "Endeavour" plants, we may recall HIERN's description of two species of Australian fig, new to science, based upon the specimens collected by BANKS and SOLANDER, and the drawings of their artist, PARKINSON (19).

After the transit of Venus expedition, BANKS did no more travel on a grand scale, but in 1772 he went to Iceland, where SOLANDER, who accompanied him, made a list of the plants collected, which are now preserved in the British Museum (20). It is, indeed, BANKS's contribution of plants to the Museum which is one of his chief claims to the gratitude of botanists. BRITTEN has pointed out that BANKS's herbarium is the foundation of the General Herbarium, and that, at the time of its acquisition, it was one of the most important in existence, and one of the most frequently cited. It contained the collections made by BANKS and SOLANDER in Malaya, Brazil, South Africa, Polynesia, Australia, and New Zealand, as well as BANKS's British plants, and those brought from Newfoundland, Labrador, and Iceland. The herbarium was not limited to personal finds, but had been increased by purchase as well as by exchange (21).

In SOLANDER, the first of BANKS's botanist-librarians, it was the botanist that predominated. After SOLANDER's death in 1782, BANKS engaged another Swede, JONAS C. DRYANDER, who, though a sound botanist, is more widely known as a bibliographer. BANKS's library consisted chiefly of works on natural history and transactions of learned societies, and is said to have been, in these departments, unrivalled in the world. The books were freely available to all workers, and DRYANDER seems to have been the perfect librarian, who could always guide readers to what they sought (22). His great memorial is a catalogue of the Banksian library, which, under the name of *Catalogus Bibliothecae Historico-naturalis Josephi Banks,* was published in five small volumes between 1798 and 1800. This catalogue is surprisingly modern in its content; it gives much bibliographical information, and a useful classification under subjects. Its importance is increased by the fact that BANKS bequeathed his library to the British Museum, which came into possession of it in 1827, so that the individual items described are now familiar to students. Many of those who have had occasion to consult early botanical books at the Museum, must have been struck by the frequency with which BANKS's name is to be found in

(19) HIERN, W. P. (1901): BANKS and SOLANDER's Australian Figs. Journ. Bot., Vol. 39, pp. 1-5.

(20) HERMANNSSON, H., *l.c.*, p. 14.

(21) BRITTEN, J. (1905): The National Herbarium (Section on the Banksian Herbarium). Journ. Bot., Vol. 43, pp. 122-4.

(22) BRODIE, B. C. (Sir) (1865): Works. Vol. I, Autobiography. London. p. 45.

rare herbals. Students of the history of botany owe him, indeed, a great debt for his discriminating collection of such works, a hundred years before it became the fashion to buy them, and for his generosity in making them over to the nation.

BANKS seems to have been as discriminating in the choice of men as of books, for the third and last of his chief assistants was ROBERT BROWN, the botanist, a greater man than either of his predecessors. BROWN had been commended to BANKS in the first place by their mutual friend, CORRÉA DA SERRA, a scientist of unusual brilliance, whose name is too seldom remembered. CORRÉA had written to him that BROWN was wishing for the post of naturalist on the voyage of the "Investigator" to New Holland in 1801. Through BANKS's influence, the appointment was made, and it was an outstanding botanical success. BROWN returned in 1805, bringing 3,600 species of plants. He was not only a great collector, but he was also both industrious and masterly in working out his material. BANKS and DRYANDER took a hand in the work, and BANKS secured for BROWN a continuation of his salary from the Board of Admiralty as long as the plants were being studied. But though BROWN was more successful in the publication of the "Investigator" plants than BANKS and SOLANDER had been with those of the "Endeavour," he was never able to produce his results in full. A first instalment, dedicated to BANKS, was published as the *Prodromus Florae Novae Hollandiae* in 1810, but the sale was so small that, after printing this first volume at his own expense, BROWN was unable to carry out the rest of his programme (23). The financial difficulty which books of purely scientific interest had to face must have been at least as great then as now; as BANKS himself wrote in 1795, "I do not know there is any trade by which less money has been got than by that of Botany." However, the *Prodromus,* despite its fragmentary nature, is so remarkable that HOOKER regarded the botanical results of the "Investigator" voyage as "incomparably greater, not merely than those of any previous voyage, but than those of all similar voyages put together" (24). It must be remembered that BROWN's work also included species collected by BANKS; in the words of the title-page, "Insertis passim aliis speciebus . . . praesertim BANKSIANIS in primo itinere Navarchi COOK detectis." Considering his intimate connexion with the *Prodromus,* it is surprising that BANKS did not finance the completion of the work; it was probably his general indifference to publication which prevented his doing so.

In the year in which the *Prodromus* appeared, DRYANDER died, and BROWN succeeded him as BANKS's librarian. BANKS ensured that, after his death, work in connexion with his library and herbarium should be continued, by bequeathing to BROWN an annuity of £200, and the use for life of all the BANKSIAN books and collections, which were to pass ultimately to the British Museum.

BROWN's *Prodromus* was not the only important systematic work

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(23) BRITTEN, J. (1907): ROBERT BROWN's 'Prodromus.' Journ. Bot. Vol. 45, pp. 246-8.

(24) HOOKER, J. D. (1860): The Botany of the Antarctic Voyage of H.M. Discovery Ships *Erebus* and *Terror.* Part III, Flora Tasmaniae. Vol. I, Introductory Essay, p. cxiv.

with which BANKS was closely associated. He had much to do with Indian botany; the East India company often consulted him about economic products, and KOENIG left him as a legacy all his manuscripts and specimens. It was the publication of WILLIAM ROXBURGH's results, however, which was BANKS's chief concern. The three folio volumes of *The Plants of the Coast of Coromandel* (1795-1819) were issued under his direction, the splendid plates being from drawings done in India under ROXBURGH's eye. Another well-known work which BANKS sponsored, was the *Icones Selectae Plantarum quas in Japonia collegit et delineavit Engelbertus Kaempfer,* of which he arranged the issue, in 1791, seventy-five years after KAEMPFER's death.

BANKS's enthusiasm for botanical travel led him to support it by all means in his power, but there was one case, late in his life, in which the botanist, whose adventure he wished to promote, drew back from the undertaking, to his patron's great indignation. The botanist in question was W. J. HOOKER; he had made arrangements to go to Java, but finally gave up the plan on account of the bad climate. BANKS reproached him severely as having preferred ease to hardship, and accused him tauntingly of a desire to stay at home and establish a family. HOOKER, however, stood his ground, and BANKS's sarcasms did their friendship no permanent injury. We may reflect that, if HOOKER had yielded to BANKS and gone to Java, and if—as was only too likely in those days when tropical hygiene was rudimentary—he had succumbed to the climate, botany might have gained by his Java collections, but it would have lost the long and effective life of his son, JOSEPH DALTON HOOKER, who was born a few years after the Java episode, and who was destined, in the late nineteenth century, to keep BANKS's memory green by editing his "Endeavour" Journal.

It is not easy in BANKS's work, which was so largely indirect, to find any very clear indication of his own personal attitude to plant study. Sometimes one is conscious of a hint of the amateur, as in his praise of Mrs. DELANY's representations of flowers in "paper Mosaick work," which he is reported to have called "*the only* imitations of nature that he had ever seen from which he could *venture* to describe botanically any plant without the least fear of committing an error" (25). Mrs. DELANY's accomplishment, which she did not begin to practice until she was in the seventies, was her own delicate and original modification of the art of paper-cutting, which flourished in the seventeenth and eighteenth centuries. The volumes of her "Flora," which are still preserved at the British Museum, include examples achieving a beauty and a realism which might have been thought impossible with such a technique. Nevertheless, BANKS's eulogy (if it was actually expressed in the unqualified terms handed down to us) is obviously exaggerated, but we need not, perhaps, take it very seriously. Mrs. DELANY, his senior by more than forty years, was a great lady of unusual charm and distinction. It is probable that BANKS's courtly manners, as well as his genuine regard, blunted the edge of his critical faculty where her art was concerned.

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(25) DELANY, M. (1861, 2): The Autobiography and Correspondence of MARY GRANVILLE, Mrs. DELANY. Ed. by Lady LLANOVER. 6 Vols. 2nd ser., Vol. 3, pp. 95-7.

BANKS's general approach to botany, so far as one can judge, started from the unquestioning standpoint of the descriptive naturalist, to whom the world of plants directly manifests the Creator's wisdom. Writing in 1769 of the flora of Terra del Fuego, "truly the most extraordinary I can imagine," BANKS expresses his wonder at "the infinite variety of creation," and "the infinite care with which Providence has multiplied her productions, suiting them no doubt to the various climates for which they were designed" (26). It was consistent with this point of view that his interest was aroused by everything connected with the utility of plants to man, and that his "Endeavour" journal includes many notes on plant products, though Dr. JOHNSON's comment, that BANKS and SOLANDER "thought only of culling simples" (27), is manifestly unfair. BANKS enumerates the various fruits met with on his travels, and, when considering those of Brazil, he speaks of bananas, which seem to have been new to him, though they had been seen in England in the seventeenth century. He explains that they are of "a consistence which might be expected of a mixture of butter and flour, but a little slimy"; in view of their popularity today, it is surprising to find them described as "disagreeable to most of our people" (28). He was always on the alert to learn about the processes employed in dealing with vegetable material. He gives, for instance, a detailed account of the manufacture and dyeing of the cloth made from *Broussonetia papyrifera* Vent. and *Artocarpus incisa* Linn. f. in the South Sea Islands, and of the uses of the New Zealand flax, *Phormium tenax* Forst., which he thought might with advantage be grown in England. The introduction of useful plants into countries that might benefit from them was indeed one of the matters that were closest to BANKS's heart. His best-known project was that for starting bread-fruit culture in the West Indies. He had much to do with the ill-fated expedition under BLIGH, which took more than a thousand bread-fruit trees on board at Otaheite, but which failed to get them to their destination owing to the notorious mutiny. However, in 1791, BLIGH was sent out again in command of the "Providence," and the bringing of bread-fruit trees to the British West Indies was at last accomplished. BANKS was responsible, also, for many introductions into New South Wales, and he did not neglect the reverse process. When economic plants and seeds were sent from England, on the return journey the same cases were filled with Australian plants.

BANKS was also in touch with the small beginnings of certain industries which have since become highly important. He was in contact, for instance, with rubber importation in its very early stages. In 1768 caoutchouc was a rarity, but BANKS brought back two balls of it from Lisbon, and a little later he received from a London merchant a small bottle made from the same substance. Again, about 1788 a "small viol of essential oil drawn from the leaves of a Gum tree" was sent to him. This was probably the first eucalyptus oil ever exported from Australia (29).

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(26) HOOKER, J. D., *l.c.*, p. 57.
(27) BOSWELL, J., *l.c.*, Vol. 1, p. 436.
(28) HOOKER, J. D., *l.c.*, p. 38.
(29) MACKANESS, G. (1936): Sir JOSEPH BANKS: his relations with Australia. Sidney, p. 31.

Many of BANKS's efforts in connexion with practical botany were inspired by the needs of Kew Gardens, of which he became the honorary director in 1772; one of his chief functions was sending collectors, under the auspices of the Government, to various countries to secure additions to the Gardens. His introductions were by no means all economic. They included, for instance, *Hydrangea Hortensia* Sieb., *Nelumbium speciosum* Willd., and *Strelitzia Reginae* Banks (30). During the reign of GEORGE III, it is said that nearly 7,000 new exotics were brought into cultivation in England, mainly through BANKS's collectors.

The practical quality of BANKS's interest in plants led him to concern himself with the diseases of wheat. Writing in 1805 (31), under the stimulus of "the alarming state of the Harvest in August last," he originated a suggestion which constitutes perhaps his chief contribution to botanical thought. "It has long been admitted by farmers," he wrote, "though scarcely credited by botanists, that wheat in the neighbourhood of a barberry bush seldom escapes the Blight. The village of Rollesby in Norfolk, where barberries abound, and wheat seldom succeeds, is called by the opprobrious appellation of Mildew Rollesby." In this passage BANKS was only drawing attention to a connexion which was recognized by many, but he goes on to ask, *for the first time,* the question, "Is it not more than possible that the parasitic fungus of the barberry and that of wheat are one and the same species, and that the seed is transferred from the barberry to the corn?" The pamphlet, in which BANKS made this suggestion, went through several editions, so that his idea must have received wide currency, but it remained unproven for nearly sixty years, until it was finally confirmed by DE BARY, with the aid of both cultural experiment and microscopical examination (32).

Though BANKS was, as we have seen, considerable as a botanist, his enduring fame rests rather on his general promotion of the subject, than on his own individual researches. The value of the part he played, with the help of his successive librarians, in making his house, over many years, a centre and meeting place for scientific workers, can scarcely be overestimated. The groups which gathered round him were cosmopolitan in character, foreign savants being warmly welcomed. THUNBERG, who was in London in 1778, writes that BANKS granted him "free and uncontrolled access to his incomparable Collections." He mentions that he spent every morning at BANKS's house, and that learned men daily assembled there, as though it were "an Academy of Natural History" (33). Six years later, FAUJAS DE SAINT FOND, on a journey which brought him to England, describes how "those who cultivate the sciences . . . assemble every morning

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(30) THISELTON-DYER, W. T. (1891): Historical Account of Kew to 1841. Section on Sir JOSEPH BANKS. Kew Bull., 1891, pp. 305-9.

(31) BANKS, J. (1805): A Short Account of the Cause of the Disease in Corn, called by Farmers the Blight, the Mildew, and the Rust. London. Printed by W. Bulmer and Co., Cleveland-Row, St. James's.

(32) RAMSBOTTOM, J. (1941): The Expanding Knowledge of Mycology since LINNAEUS. Proc. Linn. Soc. Lond. Sess. 151, 1938-9. Pt. 4, 1941, pp. 280-367. (See pp. 354-5.)

(33) THUNBERG, C. P. (1795): Travels in Europe, Africa, and Asia, made between the years 1770 and 1779. London. Vol. 4, p. 289.

in one of the apartments of [Sir JOSEPH BANKS's] extensive library . . . There all the journals and public papers, relative to the sciences, are to be found; and there the members of the party communicate to each other such new discoveries, as they are informed of by their respective correspondents, or which are transmitted by the learned foreigners who visit London, and who are all admitted into this society. A friendly breakfast of tea or coffee maintains that tone of ease and fraternity which ought universally to prevail among men of science and letters" (34). One of the most valuable features of BANKS's assemblies was that they encouraged contact between experienced workers, and younger men just entering the field of science. Sir BENJAMIN BRODIE, writing in his autobiography (35) about the Sunday evening gatherings, which he attended in the year 1805 or thereabouts, says that "The visitors consisted of those who were already distinguished by their scientific reputation," as well as "of some younger men who, like myself, were following these greater persons at a humble distance." There was complete absence of ostentation; BRODIE notes that "Everything was conducted in the plainest manner. Tea was handed round to the company but there were no other refreshments." ANDREW DUNCAN speaks of having attended a Sunday evening meeting at BANKS's house in 1815 (36), so that even the few references to his assemblies which we have cited here, cover a period of 37 years.

It is difficult now to realise that all that BANKS accomplished for botany was the work of one individual, for it corresponded to that done in these days by large associations. The informal meetings of scientific workers, for whom his house was a centre for more than a generation, played the part that congresses, and the exchange of offprints, perform today, while his munificence to those who were adding to the knowledge of botany can only be paralleled, now, in research endowments administered by public bodies.

Though public spirit was one of BANKS's most obvious characteristics, he refused altogether to follow family tradition by entering Parliament. He kept completely aloof from political activities, taking the view that science should transcend politics. Throughout the long period during which England and France were in a state of war—a period which covered more than 20 years of his 42-year Presidency of the Royal Society—he declined to be shackled by national enmities. In 1801 he accepted the foreign membership offered to him by the *Institut national de France*, and expressed his appreciation of the honour in a letter of extreme cordiality. This letter, which was made public, was considered in certain quarters to be a disloyal document, and it brought down upon him a torrent of abuse. He did not convey his belief, that science should remain above the battle, merely by this gesture, but he gave it practical effect by exerting all his influence to restore to their rightful owners such collections made by foreign naturalist-travellers as were captured by British vessels. Through his intervention with the Lords of the Admiralty and Treasury, this was achieved on no less than

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(34) FAUJAS DE SAINT FOND, B. (1907): A Journey through England and Scotland to the Hebrides in 1784. English trans. ed. by Sir ARCHIBALD GEIKIE. Glasgow. Vol. 1, pp. 2, 3.

(35) BRODIE, B. (Sir), *l.c.*, pp. 42 *et seq.*

(36) DUNCAN, A., *l.c.*, p. 18.

eleven occasions. His consistent attitude did much to preserve international cooperation in science, even between the belligerents, and the warm feeling which his beneficent activities aroused in France is preserved fo., us in the *Éloge* devoted to his memory by CUVIER. He wrote that, "Pendant cette guerre de vingt-deux ans, qui a porté ses ravages sur presque tous les points des deux mondes, partout le nom de M. BANKS a été un palladium pour ceux de nos compatriotes qui se livraient à des recherches utiles; si leurs collections étaient enlevées, il suffisait qu'ils s'adressassent à lui pour qu'elles leur fussent rendues; si leur personne était détenue, le temps de lui faire parvenir leurs réclamations était le seul délai qu'éprouvât leur mise en liberté. Lorque les mers nous étaient fermées, elles s'ouvraient à sa voix pour nos expéditions savantes" (37).

These words of CUVIER form BANKS's fittest epitaph.

CAMBRIDGE,
ENGLAND.

STANLEY A. CAIN: **The Place of Pollen Analysis in Paleo-Ecology**[1]: — Peat deposits—and frequently the sands, silts, clays, mucks, or marls associated with peat—contain micro-fossils of which the pollen grains of wind-borne species are especially important and frequently abundant. The method of pollen analysis consists of the identification and tabulation of numbers of pollen grains and spores of each type at various depths in the sediments. Shifts in fossil pollen composition of the deposits from layer to layer are interpreted in terms of vegetational and climatic history. The science was elaborated about twenty-five years ago by two Swedish scientists, Professor LAGERHEIM of the Department of Botany at the University of Stockholm and Dr. VON POST (1918), now Professor of Geology at the same school.[2] The method was quickly realized to be one providing excellent opportunity for Quaternary and Pleistocene geological, biological, and climatological studies. It spread rapidly through the north-European countries and more gradually was taken up by investigators elsewhere until its literature at the present time consists of about two thousand titles.

Percentage occurrences of pollen grains and spores in any sample are called a pollen spectrum. A chronological series of spectra derived from samples taken at different levels in a deposit constitute a section, and expressed as curves of changing composition constitute a pollen diagram. It is the pollen diagram of the fossils of a deposit, or a series of them from an area, which forms the basis for an understanding of the history of the vegetation and climate of a region.

The VON POST hypothesis of postglacial history derived from his pollen studies describes three generalized climatic phases: (1) an early postglacial period of increasing warmth during which there was a recession of arctic and boreal species and a first advance and increase of relatively heat-requir-

(37) CUVIER, G. L. C. F. D. (Baron) (1827): Recueil des Éloges Historiques. Vol. 3. Paris. Éloge Historique de Sir JOSEPH BANKS. Lu le 2 Avril 1821.

[1] Contribution from the Department of Botany, The University of Tennessee, N. S. No. 71. *This essay was originally presented as an invitational lecture before Sigma Xi at The University of Tennessee.*

[2] An excellent concise historical account of the beginnings of pollen analysis as an independent science and as a tool in other sciences is to be found in the new book by ERDTMAN (1943), *An Introduction to Pollen Analysis* published in VERDOORN's "A New Series of Plant Science Books."

ing species; (2) a middle stage of maximum warmth and a culmination of the invaders of the preceding period; and (3) a final period of revertence to contemporaneous conditions due to decreasing warmth.

Pollen analysis is a highly specialized method in the fields of ecology and paleontology, and it is the purpose of this discussion not so much to describe in detail any of its results as to place it in its proper relationship to ecology and paleontology, especially paleo-ecology and paleo-climatology. Before going on with this task, however, I wish to make it clear that there are other phases of paleontology that employ microfossils, and that there are other approaches to vegetational history and paleo-climatology.

Students of contemporaneous patterns of plant and animal distribution, especially when they simultaneously employ the probable evolutionary history of a group, have been able to make searching deductions concerning the past history of climatically controlled communities and taxonomic groups. The pioneer essays of ASA GRAY (SARGENT, 1889) on forest archeology, including the history of eastern American and Asian floras and stories of such interesting trees as the *Sequoia*, have been followed by the work of other geographers, such as that of FERNALD (1925) on the flora of the nunataks of St. Lawrence valley, GLEASON (1923) on the vegetational history of the Middle West, HULTÉN (1937) on Arctic floras, LIPPMAA (1938) on Eurasian Tertiary relics, PEATTIE (1922), FERNALD (1926), BRAUN (1937), and PENNELL (1935) on Coastal Plain affinities, and CAIN (1943) on the Tertiary nature of the cove hardwood forests of the Great Smoky Mountains. GLEASON (1923) hypothesized the three-phase character of postglacial climate on a basis of modern distributions without reference to fossils, and GRIGGS (1942), MARIE-VICTORIN (1929), RAUP (1937, 1941), COOPER (1937), and others have made deductions as to the recent climatic revertence on a basis of studies of timberline, the retreat of glaciers, etc.

Geological studies of varved clays, physiographic studies on river and coastal-plain terraces, pedological studies of fossil soils, and the investigations of loess by HOBBS (1943) are examples of other approaches than the biological to the problems of Pleistocene and postglacial climates.

One of the most interesting modern approaches to paleo-climatology that has come to my attention is based upon studies of soil development. At Praesum, in the Davis Mountains of western Texas, BRYAN and ALBRITTON (1943) have interpreted certain polygenetic soils as indicating climatic variations in the moisture factor. They say, "According to one interpretation, this soil records three stages of relative aridity during which caliche was deposited in the subsoil, and two intervening stages of moister climate during which the previously deposited caliche was partially or entirely dissolved. This interpretation is in harmony with the climatic evidence in the adjacent valley flats, which are underlain by three bodies of alluvium separated by erosional disconformities. On the evidence of the alluvium itself (ALBRITTON and BRYAN, 1939), it had already been postulated that deposition took place during relatively humid times, whereas erosion of the valley flats in gullies, now identifiable in the surfaces preserved along disconformities, occurred during relatively arid times. The pedologic and geologic records seem therefore to be in harmony with each other . . . ."

Although this discussion will treat pollen grains that are fossilized but not

mineralized and that represent very recent time, geologically speaking, it should not be thought that work with microfossils is necessarily so limited. WODEHOUSE (1932, 1933), in describing the pollen grains of the Tertiary Green River Formation, has done an excellent piece of work on more ancient pollen grain flora. Also, a considerable body of research is being carried out on the spore content of coal and its usefulness in coal stratigraphy, very much as earlier work with foraminifera was useful in oil-shale stratigraphy. Chapter XVIII in ERDTMAN'S *An Introduction to Pollen Analysis* (1943) reviews the literature on Tertiary spores and pollen grains and lists some 250 named forms.

*The philosophical basis of ecology.* — There are a few major principia of ecology that are of peculiar interest for this discussion which will provide a partial basis for relating pollen analysis to the broader field.

The common observation that organisms do not live everywhere, but each lives only under certain more or less limited types of environments and does better under conditions well within the extremes of environmental conditions that are tolerated, has led to the principle of physiological limitation. The seeds of plants are not like the seed of Truth which "however broadcast will catch somewhere and produce its hundredfold." Although there are some species of strikingly limited tolerance and others equally remarkable for the breadth of their ecological amplitude, there are no truly ubiquitous or cosmopolitan organisms.

The result of the preceding principle, and the fact that environmental conditions vary from place to place, is that plants and animals of similar requirements tend to live together. Thus the landscape takes on the familiar cast that we have come to expect of bogs and marshes, deciduous woods and spruce forests, sand dunes and salt marshes, mangrove swamps and rainforest, hot desert and cold tundra. But these associations are not mere aggregations of individuals who have "tastes" in common. Rather, they are highly integrated communities which have developed, in many instances, complicated composition and structure on a basis of cooperation and disoperation (CAIN, 1939*b*).

These observations lead to the inseparable twin principles of ecology— the concepts of succession and the climax (CLEMENTS, 1916). The principle of succession is essentially that of self-provoked change. Each community—from the pioneer aggregation of hardy individuals on new land to the climax aristocracy—in living on the land and from the land, reacts on the land so changing the conditions of life that these conditions become more suitable for new plants than for the present ones. Thus, on the bare sands and gravel of a glacial outwash-plane once flourished the low plants of the tundra. Superseded by grasses or the willows and aspens of the forest border, after the way had been prepared, the latter were in turn dispossessed by oaks and hickories.

There comes a time when the aristocracy has arrived and consolidated its hold beyond dispossession through competition, over-crowding, and over-towering. The composition and structure of the community no longer change progressively and a condition not of stability but of dynamic equilibrium is reached. This is the climax—the biome of plants and animals that represents the highest expression of community development that

is attainable under a given climatic regimen (CLEMENTS and SHELFORD, 1939).

*The philosophical basis of paleo-ecology.* — Paleo-ecology is the science or sometimes art of reconstructing past vegetation and climate from biological and physical indications. Its principal materials are fossil floras and faunas which are understood to have indicator value concerning past conditions just as different biological types have in modern times indicator value because of the close relationship which exists between specific requirements and the environmental conditions which meet the specific needs.

It becomes apparent from the fossil record that climate has varied in the past. Within a single area there may occur a geological sequence of floras representing in chronological order the joint climatic-biological history of the area. Also, on a combined historical-geographical basis it is possible to sketch, at least in broad strokes, the spatial pattern of biomes and climates at any one time and the migration over the surface of the earth of any one biome with the passage of time (CHANEY, 1936).

It is not now necessary to consider the complex causes of climatic change. It should, however, be emphasized that the success of the paleo-ecological method depends jointly upon two considerations. In the first place, the fossils must be accurately identified. This is not a matter of attaching to a fossil an acceptable binominal, but a far more difficult and critical task of recognizing the life-form of the fossil and its consequent indicator value because of its membership in an association which, as a whole, requires a certain definite *Lebensraum* and *Lebensfähigkeit.* The second factor, of course, is that such interpretations must be based upon a considerable body of information concerning the ecological relationships of modern organisms and communities, especially with respect to adaptive structures and functions. The practical and philosophical aspects of paleo-ecology are treated at length in *Foundations of Plant Geography* (CAIN. 1944).

Paleo-ecology becomes progressively less authoritative the more ancient the flora under study, because the more remote the taxonomic relationships of the fossil forms from contemporaneous species, the less certain one can be as to the ecological significance of the fossil. As a consequence, paleo-ecology is most successful for the Cenozoic, is remarkably suggestive for the Tertiary, and is highly questionable anterior to the Cretaceous modernization of floras.

Each fact, whether it be biological or physical, must take its proper place in the primary causal sequence of climate—plants—animals. For example, fossils of an herbivorous mammal at once suggest both a grassland climax and climate. In the mountains of Trans-Pecos Texas wind-polished rocks indicate a period of erosion and relative dryness, and a more xerophytic vegetation and climate than prevail at the present. BRYAN and ALBRITTON (1942) date these wind-polished rocks as Neville-Calamity period of about 5,000 to 7,500 years ago—a nice parallel with biological evidences in the Middle West for a post-Wisconsin xerothermic period. A dominance of spruce pollen grains at the bottom of a sedimentary basin in Indiana (POTZGER, 1943; WILSON and POTZGER, 1943*a*) points both toward the nature of the climate that prevailed at that time and toward

the animals that were probably associated with the vegetation type, whether or not bones of the animals be discovered.

*The principles of pollen analysis.* — Pollen analysis, being a technique in the general field of paleontology, employs the same principles as paleontology and paleo-ecology. In so far as it is specialized, however, its bases and emphases are different, or at least more narrow. From this point of view it can be said that the science of pollen analysis rests upon the following facts (GODWIN, 1934; CAIN, 1939*a*, 1944; ERDTMAN, 1943).

1. Most dominant trees of the temperate zone have wind-borne pollen. This fact results in a general pollen rain for a locality which contains a mixture of the grains of the available species.

2. Many of the grains of the pollen rain which fall onto a bog or other receptive surface, or which settle through the water to the bottom of a pond, are preserved under the more or less antiseptic, low-oxidation conditions.

3. Year after year, as the peat or other sediments accumulate, stratified pollen deposits occur.

4. Proper methods of sampling and preparation of the samples allow the detection, identification, and counting of the fossil pollen grains which usually occur in abundance.

5. The structural characteristics of pollen grains are constant for a species, or at least as constant as other morphological characteristics of species. It does not follow, however, that the species of a genus can always be told apart.

6. Consistent general trends in the pollen spectra from a section, based upon percentage composition of component pollen grain types, are a fact in most records.

7. When numerous sections are available over a wide geographic area, regional correlations permit a reconstruction of the general outlines of vegetational migration and succession, together with an approximate or relative dating of the principal events.

8. The phenomenon of regional parallelism of development is that given climatic changes induce equivalent but not identical changes in forest composition in different parts of a country.

*Sources of difficulty and error in pollen analysis.* — No general discussion of pollen analysis should omit emphasis of the fact that many of its conclusions are deductive, and that the future of this young science depends greatly upon its striving for a more completely inductive basis. Let us consider some of the sources of difficulty and error in pollen investigations.

1. *Truncated records.* Judging from their conclusions, it seems to have been a tacit assumption of several students of post-Wisconsin peat profiles that their observations covered the whole period of time since the recession of the ice sheets. Quite the reverse is commonly the case. POTZGER and RICHARDS (1942) concluded that most of the records from bogs and lakes in the Middle West are from profiles truncated at the bottom. As a result, the early period of spruce dominance is frequently missed or represents too short a time. They attribute this situation to errors in sampling due to boring the bog away from its deepest area, failing to sample the early deposited sands, or failing to penetrate a false sandy bottom to underlying pollen-bearing sediments. Even when the sampling has been

complete, the pollen record may omit long periods of the early vegetational history because of physical conditions which prevailed in the sedimentary basin. For example, after the ice sheet withdrew from an area, a kettle-hole may have been blocked for centuries by dead ice before becoming a pond. A profile may be truncated at the top also when a bog has become senescent or the surface layers modified or destroyed. Bottom truncation because of faulty technique is shown by a series of recent papers as a common condition (POTZGER 1943; WILSON and POTZGER, 1943*a*, 1943*b*).

2. *Bog surface receptivity.* It appears that pollen preservation depends considerably upon the receptivity of the surface and the conditions for quick preservation. The pollen spectra of a profile may be quantitatively misleading as to forest composition because of changes in the bog surface. Hence, bogs in an inactive state, with no peat being formed because of excessive dryness or cold, may not preserve pollen, or may preserve some grains better than others. Also, even a relatively slight change of temperature conditions may result in the surfaces of sedimentary basins being still frozen at the time that early tree pollen is disseminated.

3. *Differential preservation of pollen.* The pollen grains of different species do not have walls that are physically and chemically alike. For this reason and also because bogs differ in their physical, chemical, and biological activity, the pollen grains of certain species are rarely preserved (ERDTMAN, 1943). Fortunately most tree pollen grains preserve equally well, but reports in the literature indicate that hazel, poplar, aspen, ash, maple, yew, juniper, larch, bald cypress, and swamp white cedar are usually strongly under-represented or lacking because of poor preservation.

4. *Morphological similarity of unrelated grains.* The identification of pollen grains is in many cases difficult enough at the best because of their limited morphological characteristics. In some instances it appears likely that erroneous interpretations of forest structure have resulted from mistaken identifications. For example, birch, hazel, hornbeam, and myrica are closely similar, although they can be distinguished under favorable conditions and close study. The pollen grains of beech and *Hippophaë*, of oak and violet, of willow and ash, and hazel and nettle are so closly similar that they may cause confusion.

5. *Determination of species.* Although there are good reasons for believing that the specific characters of pollen grains are as constant as are other small morphological features, it is unfortunately true that the grains of different species within a genus are usually closely similar. Since the principal objective of pollen analysis is to discover the nature of past vegetation and climate, the success of the method depends for its refinement on the identification of species. At the present time determinations are usually made only to the genus because of a lack of methods for distinguishing species within the genus. Larger historical changes are detected by characteristic shifts in pollen composition, such as from dominance by spruce or spruce-fir to dominance by pine, pine-oak, and oak-hickory, as is characteristic of many middle western profiles. There are frequent situations, however, where generic determination is insufficient or misleading because a large genus contains species of strongly contrasted ecological requirements. The pine and oak genera are good examples because some of their

species indicate dry and others moist or wet situations while some are characteristic of cold and others of warm or hot climates.

6. *Under- and over-representation.* Not only is the qualitative pollen-grain composition of a deposit important in suggesting the composition of the forests which surrounded the sedimentary basin at different times, but quantitative relations are usually understood as indicating the structure of the vegetation and the probable species that were dominant. There are, however, several reasons for believing that certain species are characteristically over-represented and other species under-represented in the usual pollen percentages.

One of the primary causes of the failure of pollen percentages to coincide quantitatively with vegetational composition is the varying abundance of pollen grains produced by different species. Most of us have seen or heard of the "pollen snow" or "sulphur showers" produced by pine forests. Last spring I walked through a hardwood forest in the Great Smoky Mountains at the time yellow birch pollen was being shed, and my shoes and trousers were soon yellow with pollen that had settled all over everything. ERDTMAN (1943) states that one birch catkin may produce as many as ten million grains. HESMER (1933) states that the following list of genera is arranged according to decreasing quantities of pollen production: pine, hazel, alder, birch, hornbeam, fir, spruce, beech, and oak. Also, it is a common observation that insect-pollinated species are under-represented by pollen. This group includes such genera as basswood and buckeye.

There is every reason to believe that most of the pollen preserved in a particular sedimentation is of local origin, but it is also apparent that the pollen of species that are abundant pollen producers may be blown considerable distances and produce an over-representation, in a particular deposit, so far as local vegetation is concerned.

The only way to obtain reliable data concerning over- and under-representation in fossil deposits is to study the phenomenon in currently accumulating deposits. In the few studies of this nature the principal techniques are to trap the modern pollen rain or to extract the pollen from moss polsters which act as natural traps, and to compare the resulting pollen analysis with the existing composition of surrounding vegetation. (CARROLL, 1943).

7. *Climatic interpretation.* Since the interpretation of paleo-climates rests largely upon the quantitative relations of fossils, all the preceding sources of error present hazards to the ultimate step of the science of pollen analysis. There is, however, an additional relationship that should be remarked. Only climax vegetation is in complete harmony with a prevailing climate. Even under primeval conditions no large area is completely occupied by the climax, and successional communities occupy greater or lesser parts of the area because of catastrophies such as are caused by fire, hurricane and disease, and by degradation and aggradation. There sometimes arise questions as to whether a change in forest composition, as indicated by a shift in pollen composition, was caused by climatic change or was merely the result of normal successional development.

*Concluding statement.* — In the preceding discussion I may have left the impression that the numerous difficulties and sources of error make pollen analysis a futile field of investigation. Quite the contrary, however,

is the case. Early in the development of the science of pollen analysis LAGERHEIM (ERDTMAN, 1943) concluded that pollen analysis provides "a reliable method with which to follow, step by step, from one layer to another the immigration of all plants whose pollen and spores are preserved as fossils as well as the relative frequency of these species." ERDTMAN (1943) says that "in a carefully investigated region it is possible to determine the relative, in certain places even the absolute, age of a pollen-bearing sample and to ascertain its place in a system of curves, illustrating changes in vegetation and climate, during ages long past." The work of SZAFER (1935) on isopolls illustrates a mature stage of interpretation of forest history from pollen analysis.

In spite of all the qualifying factors there is a widespread confidence in the general story of postglacial vegetational and climatic history as worked out from pollen studies. In addition to lesser contributions to knowledge, pollen analysis, along with other evidence, has already established two important facts. One, the law of regional parallelism, refers to the fact that a general climatic change produces in the various areas of a region comparable but not identical changes in the vegetation so that it is possible to establish a geographic synchronism and cross-dating. The other important observation which is supported by the evidence of pollen analysis is that in recent centuries of postglacial time a climatic deterioration seems to have been taking place, and we may be slowly and inexorably returning toward an ice age.

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A. C. SMITH: **The Principle of Priority in Biological Nomenclature:** — A recently published article on the subject of nomenclature (1), although addressed primarily to zoologists, should perhaps be contemplated by plant taxonomists as well, because its implications extend over the whole subject of biological nomenclature. That the article has a semi-official status is indicated by a heading to the effect that the Reichsbund calls this article to the attention of interested members and requests them to return the attached card, signifying their agreement with the sentiments expressed, to Prof. K. ESCHERICH.

In a foreword, Dr. HEIKERTINGER states that recently "a number of zoologists" have drawn up two resolutions: (1) all changes of names for reasons of nomenclatural priority are to be avoided until present-day conditions are finally settled, and (2) a committee is to be formed to determine, for the most important species of insects, which of the names at present under debate should be recommended for use, in order to preserve uniformity. Prof. ESCHERICH, who is apparently a moving spirit, has received a great majority of favorable replies to these proposals. Postcards are enclosed with the reprint (which appears to have been widely circulated in Germany), and all those engaged in biological fields are requested to return the cards, expressing their agreement, to Prof. ESCHERICH. One fails to find, in this foreword, any provision for those who wish to express disagreement, although there are certainly many such among our German colleagues.

(1) HEIKERTINGER, FRANZ. Das Nomenklaturproblem der Gegenwart. Zugleich ein Aufruf an alle Biologen. Der Biologe 1942:20-27.

The body of the paper opens with a complaint about name-changing from a well-known name to an earlier one, especially when this change is made abruptly. The only type of name-changing which appears to be desirable to Dr. HEIKERTINGER is the replacement of foreign words, such as "tramway" and "aëroplan," by German words such as "Strassenbahn" and "Flugzeug." But to replace a well-known name of a biological entity by a lesser-known earlier name is anathema to Dr. HEIKERTINGER. He wants to preserve the uniformity and stability of nomenclature by retaining the better-known recent name rather than reviving an older forgotten one.

It seems that, according to the author, zoological nomenclature was more or less stabilized about 1850, because of the thorough monographs of that period. [Whether this was actually the case in the field of zoology the present writer cannot say, but every plant taxonomist knows that 1850 was no golden age of plant monography.] These zoological monographs, one is led to believe, should be preferred to the older often superficial works, even when the monographic concept of a species differs from the original concept, and even when this difference in concept is caused by the monographer's misinterpretation of an earlier writer's type specimen.

It is not necessary to cite the innumerable horrible examples Dr. HEIKERTINGER gives of the confusion caused by upsetting well-known names, examples to show what chaos modern systematists have wrought among the butterflies, birds, rabbits, flies, bugs, etc. Suffice it to say that Dr. HEIKERTINGER is very, very much concerned with the state of affairs, much of which seems to be due to the dictatorial methods of Dr. C. W. STILES, the American perpetual chairman of the International Commission on zoological nomenclature. Dr. HEIKERTINGER cannot bear dictatorial methods. He finds intolerable the "bureaucratic procedure" at present involved in having a later homonym conserved over an earlier name, as permitted for genera.

In conclusion, Dr. HEIKERTINGER suggests a "surprisingly simple formula": the valid name of a genus or species is the one which the monographer finds in scientific usage, regardless of whether or not this is the earliest name; if a genus or species has two names in usage, the monographer must choose as valid the one whose retention will cause the fewer nomenclatural changes in scientific literature [as a concession, the conscientious monographer, if unable to decide which name meets these specifications, may select the earlier name]. This proposal is called "the principle of continuity" [probably not, however, referring to the fact that it continues the use of erroneous names] (2).

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(2) A proposal somewhat suggestive of Dr. HEIKERTINGER's "Verjährungsprinzip," at least as regards generic names, was incorporated in a series of suggestions by a group of German botanists in 1897 (ENGLER, A. *et al.*, Nomenclaturregeln für die Beamten des Königlichen Botanischen Gartens und Museums zu Berlin. Notizbl. Bot. Gart. Berlin 1: 245-250). Their proposal was to consider as obsolete generic names not used for 50 years. When the Vienna Congress of 1905 rejected this principle, in formulating the first draft of our modern Code of Nomenclature, the Berlin group dropped it. The list of *nomina generica conservanda* makes such a principle superfluous, and among botanists it has few, if any, supporters at present. That zoologists are further from agreement on nomenclatural matters than botanists is indicated by a recent article entitled "General Council on Zoological Nomenclature," in Science n. s. 97: 403-404, 1943.

If this principle of continuity is put into zoological usage [and doubtless the botanists will be converted later], we may expect the following felicitous results: "in 30 years every species of animal will thus have one single universal name in use"; "this principle will provide an unwritten list including all species of animals"; "every justified priority will be protected by this formula."

In brief, Dr. HEIKERTINGER'S paper is an undisguised attack on the principle of priority and, in effect, a plea for *nomina specifica conservanda.* It again brings into the open a conflict which most taxonomists had long thought settled. As far as plant taxonomists are concerned, every proposal to set up a system of *nomina specifica conservanda* has been decisively rejected by International Botanical Congresses. At the Amsterdam Congress of 1935 such a proposal was rejected by a vote by secret ballot of 208 to 61. Repeated rejections of this principle have convinced most plant taxonomists that the desire of a great majority of them is to retain the present principle of strict priority for specific names. It is the present writer's belief, from discussions with numerous colleagues, that the Amsterdam majority of four to one does not give a true picture, and that the minority favoring *nomina specifica conservanda* is actually far less than one-quarter of the active plant taxonomists throughout the world (3).

It must be obvious, to any observer with a long-term point of view, that a nomenclatural system based upon the sanctity of monographic work cannot be satisfactory. It is the height of naïveté to believe that today's best monograph will be adequate in a hundred years. For an International Congress—at least in the field of botany—to bind its members to accept erroneous interpretations is a transgression of scientific integrity. Certain plant taxonomists have suggested that a list of *nomina specifica conservanda* will be practicable if it is kept very small and the names carefully selected. But everyone knows how such lists grow, each name seeming absolutely imperative to somebody. To accept such a principle, and to begin such a list (even if "unwritten"), is to invite a degree of "bureaucratic procedure" which would cause Dr. HEIKERTINGER no end of agitation. The sober fact is that supporters of the principle of *nomina specifica conservanda* overestimate the importance of their work, overvalue the need for nomenclatural stability, and grossly overestimate the number of people affected by biological nomenclature. However important it may seem to some individual to retain a certain "well-known" name, the fact is that no scientific name is well-known to the general public, and it simply does not matter to the average human being what we professional biologists call our species. We should delude ourselves in thinking that the names we apply to organ-

(3) A different impression may be given by a recent article by WILLIAM A. DAYTON, on "The Names of the Giant Sequoia," in Leafl. West. Bot. 3:209-219, 1943. In this article several prominent Californian botanists permit themselves to be quoted as unqualifiedly in favor of *nomina specifica conservanda.* The fact that the name *Sequoia gigantea* is not valid under the International Code apparently arouses the patriotic fervor of loyal Californians. The cited article is an illustration of the methods which pressure groups all over the world will use to persuade future International Congresses to open a list of pet specific names. All taxonomists who foresee the endless bickering and petty bargaining which would follow a rule permitting *nomina specifica conservanda* should attend the next International Congress prepared to vote down this perennial proposal.

isms have any fundamental consequence. Nomenclature should remain merely a tool to permit the facile discussion of biological entities, and a tool with as few ornaments as possible. It has been agreed, for generations, that the principle of priority is the blade of this tool.

The question may be asked: Since we agree upon the use of a list of *nomina generica conservanda,* why not a similar list of *nomina specifica conservanda?* Is the first list perfectly ethical and desirable, while the second is an affront to our scientific integrity? One must admit that, fundamentally, the moral issue at stake is similar in the two cases. But the practical issues involved are infinitely more complicated in the matter of specific names. Many botanists doubtless feel somewhat uncomfortable when they resort to the list of *nomina generica conservanda,* for this is indeed a contradiction of the rule of priority. At best, it is a compromise between integrity and reality. But at least we may comfort ourselves with the reflection that, were it not for this list of about 850 generic names (4), thousands upon thousands of specific binomials would be invalidated. The conservation of established generic names is obviously of more importance than the conservation of even the best-known specific names, even though this importance is merely a matter of degree. Perhaps only a very few plant-taxonomists would advocate the abandonment of *nomina generica conservanda;* most of us are not such idealists as to defend a principle at the cost of great inconvenience.

It may be admitted that there is nothing sacred about the principle of priority. It was established by long custom and finally enacted into a sort of gentlemen's agreement—the International Rules. Surely, one may say, it may be revised or repealed by the same body which accepted it, the International Congresses. This is certainly true, and one is perhaps not justified in defending the principle of priority on ethical grounds. But before this principle is replaced or further amended, the issues involved should be carefully examined by all concerned, and the substitute proposal should be more sound and more practical than the principle to be abandoned. That Dr. HEIKERTINGER's "principle of continuity" falls into this category one is justified in doubting.

There is a further issue, and perhaps a more fundamental one than the conservation of later specific homonyms: Dr. HEIKERTINGER's proposal incorporates the suggestion that the specific name in current usage is to be preferred over an "obsolete" name, even in cases where the currently used name is based upon a misinterpretation of the type specimen (*e.g.,* his illustration of *Lepus timidus* vs. *Lepus europaeus,* etc.). That is, one is permitted to reject the original author's concept in favor of the concept, however erroneous by the standard of the type method, of some later monographer. The ethical issues here involved do not call for comment. Whatever other charges may be leveled against the list of *nomina generica conservanda,* it cannot be said that this list is ever knowingly used to contravene the original author's concept.

A certain degree of support for Dr. HEIKERTINGER's ideas in botanical circles is indicated by a more recent short note by Dr. AICHINGER (5). The

(4) International Rules of Botanical Nomenclature, ed. 3. Appendix III, 1935, and Kew Bull. 1940: 89-130, 1940.

arguments for legislated "stability" of plant names set forth by Dr. AICHINGER are not very impressive. The fact that "Aus dem Verantwortungsgefühl für unsere studierende Jugend heraus halten wir es für untragbar, dass der Student alle paar Semester umlernen muss . . . " (surely somewhat exaggerated) scarcely causes us to shed a tear, since this same "studierende Jugend" is expected to discard preconceived notions of all other branches of biological science at the drop of a chromosome. Why is it that workers in other fields of biology expect absolute stability of systematics (that is, comparative morphology and its attendant nomenclatural expression), while they are willing to accept any degree of flux in the fields of genetics, physiology, cytology, and plant sociology?

Nomenclatural stability will not be achieved by fiat; there is no short-cut by which certain names can be indefinitely affixed to certain concepts. The solution lies not in re-writing and amending a set of Rules—it lies in good, sound monographic work, based on all possible material, bibliographic sources, and techniques. Concern as to "name-juggling" is not limited to plant sociologists, like Dr. AICHINGER, and struggling students; all biologists are concerned. Names are not wantonly changed by responsible systematists, but certain changes are dictated by necessity—necessity too often caused by the inadequate and careless work of an earlier generation of taxonomists. If the amount of energy which is directed toward criticism of the International Rules of Botanical Nomenclature were turned to careful and profound monographic study, we should have, that much sooner, a set of monographs which could be taken as authoritative and which would automatically "stabilize" nomenclature, without additional legislation. Good monographs stand up for a long time; poor ones are soon ignored. To "standardize" the names set up by both good work and poor, indiscriminately, is patently unsound. Time and the researches of future generations are the only adequate tests thus far devised for biological monographs.

A curious discrepancy exists between the end desired and the means proposed by Drs. HEIKERTINGER, AICHINGER, and their supporters. In their desire to retain the names to which they are accustomed (and many of these names are admittedly in use due to erroneous interpretations or inadequate bibliographic research), they are entirely conservative. But the means by which they propose to preserve these names—an abrogation of the time-honored principle of priority in favor of a rather vague "principle of continuity"— is certainly radical, for it means a sharp break with the traditions and usages of generations of scientists. Adherence to the principle of priority is not incompatible with stability of nomenclature. Such stability will not be achieved in the immediate future, but a reasonable degree of stability will be more quickly achieved if studies are founded on the firm basis of competent investigation, thorough bibliographic research, and the principle of priority.

It should be mentioned that many American scientists favor legislation of the type proposed by Drs. HEIKERTINGER and AICHINGER (6), and that various "usage rules" have been suggested in articles of diverse degrees of vehemence. Some tirades of this type, as all taxonomists know, are cleverly

(5) AICHINGER, E. Betrifft: Nomenklatur der Pflanzen und Pflanzen-Gesellschaften. Der Biologe 1942: 196-197.

written and highly diverting, while others are couched in such flippant language, and disclose such a total misunderstanding of taxonomic procedure, traditions, objectives, and limitations, that they are not to be taken seriously; yet, because they doubtless influence the thinking of many workers in associated fields, they can scarcely be altogether ignored. Too many criticisms of the present Rules of Botanical Nomenclature are based upon the assumption that professional systematists are playing a malicious game which has no relation to the biological sciences. The authors of these criticisms tacitly assume that systematists already have reached all the conclusions necessary regarding the classification of plants and animals, and that only their innate perversity prevents them from publishing a final and immutable list of the "correct" names of all living things. Immutability is not to be found in science, least of all in a virile branch like systematics, which builds upon facts disclosed by many other disciplines, each of which in itself is vigorous and, as human endeavor goes, young.

It would seem entirely unnecessary to bring up such a fundamental subject as the principle of priority in botanical circles. But in the papers which have called forth the above discussion we see attempts to replace a valuable and tried principle by one which is both impractical and unnecessary. It may be that the time will come when American biologists will receive a reprint similar to Dr. HEIKERTINGER'S, with an accompanying postcard for return to an American Prof. ESCHERICH. At that time, one may hope, these postcards will find a more apt depository than the mailbox.

Since the foregoing article was set in type, Dr. VERDOORN has called the writer's attention to an article by Dr. R. MANSFELD,[7] discussing the same problems. In this paper Dr. MANSFELD points out that, although the fundamental principles enunciated in the Rules pertaining to botany and zoology are essentially similar, the present-day situation is quite different, because of the failure of the Rules of Zoological Nomenclature to set up adequate machinery for exceptions. Dr. MANSFELD is inclined to believe that Dr. HEIKERTINGER'S "principle of continuity" is a poor substitute for the principle of priority, at least in the field of botany; furthermore, one may read between the lines a suggestion that zoologists would do well to consider the compromises worked out by botanists. It is refreshing to discover that both sides of this question are being discussed in Germany and that all German biologists do not "express their agreement" to Prof. ESCHERICH.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

F. R. FOSBERG*: **The Work of the Botanists of the Cinchona Mission in Colombia:** — Perhaps some readers of CHRONICA BOTANICA may be interested in some of the doings of their botanical friends in the Colombian Cinchona Mission. As you know, I have been engaged in the ex-

(6) For instance: HARLOW, WILLIAM M. Scientific Names and their Vagaries. Journal of Forestry 40: 960-962, 1942. DAYTON, WILLIAM A. Should Plant Taxonomists be Controlled by an Open Season or Otherwise, or Altogether Suppressed? *op. cit.* 41: 369-373, 1943.

[7] Nomenklaturregeln und Nomenklatur in der Botanik und in der Zoologie. Ber. Deutsch. Bot. Ges. 60: 373-383, 1942.

* Senior Botanist, Foreign Economic Administration. — Since the above was written all interest in the scientific aspects of the Cinchona problem has been dropped by the Foreign Economic Administration. The men are scattered in various other jobs. The data and collections are being turned over to the U. S. Department of Agriculture, which will carry on the investigation but on a much reduced scale.

ploration of the Republic of Colombia for sources of wild *Cinchona* bark since November, 1942. For the first eight months besides myself there were engaged in this work, under the auspices of, at that time, the Board of Economic Warfare, BILL STEERE and two foresters, DONALD WINTERS and WILLIAM SILCOCKS. The exploration program was for several months under the direction of LESLIE R. HOLDRIDGE, who left for another assignment in February, 1943.

In May, WINTERS and SILCOCKS severed their connection with the program, and STEERE was sent to Ecuador to carry on exploration there to start the development of the *Cinchona* resources of that country. This left me to carry on the job alone in Colombia. For several months I tried to be at many places at once. As the magnitude and urgency of the task, as well as the impossibility of doing an adequate job became apparent, steps were taken to get assistance, and, in all, ten more botanists and foresters were sent down to work with me and Colombian helpers were trained to travel with them. The botanists and foresters were, in order of arrival, EARL CORE, HENRY KERNAN, ANDREW L. MCCOMB, CHAPIN JONES, ELBERT LITTLE, FRED HERMANN, NORMAN FASSETT, MARTIN GRANT, HAROLD ST. JOHN, and JOE EWAN. Of these, FRED HERMANN was soon transferred to the insecticide procurement program and CHAPIN JONES was reassigned to Washington. The rest are still actively working in Colombia.

From a botanical point of view, as well as from that of producing antimalarial alkaloids for use in the war, our work in Colombia has been an unqualified success, exceeding all expectations. Insofar as the Colombian species are concerned, materials have been assembled for a definitive monograph of the genus *Cinchona* and its immediate relatives. The details of the distribution and variation of *Cinchona* within Colombia have been worked out, with the exception of a few areas now being explored, to an extent which is probably more complete than for any other large tropical genus in a similar area. The men now working in Colombia are busy filling in the few important gaps remaining in our knowledge of the genus.

The results, up to the present time, seem to support STANDLEY's conservative view of the genus, recognizing for Colombia only four species in the genus *Cinchona* proper, *C. henleana* being more closely related to a group of species in the genus *Ladenbergia*. In contrast to the view of STANDLEY, however, there appear to be many well defined geographical varieties in *C. officinalis* and *C. pubescens*. These differ markedly in gross morphology, bark morphology and analytical characteristics. The question of the distinctness of *Ladenbergia* and *Remijia* from *Cinchona* is by no means settled, as yet, and much more study of the material collected is necessary before even an opinion can be hazarded.

The plan of work, since my staff was built up to its present size, has been to have each man work mainly in a separate portion of the country and to get to know that section sufficiently to become an authority on its *Cinchona* resources, geography, transportation, and labor conditions, all of which bear an important relation to bark production. My own work, in addition to getting the others started and directing their efforts, has been in gaining sufficient familiarity with the entire country to correlate and use their results in advising and assisting the procurement program, working

out methods of distinguishing the kinds of bark, correlating the analytical and botanical data, and writing two editions of the Colombian Cinchona Manual, an elementary presentation of the scientific aspects of the Colombian *Cinchona* program for the use of the 120 or more members of the *Cinchona* Mission staff in Colombia, as well as for the staff in the Washington office.

CORE has worked mainly in the western part of Colombia, in the departments of Cauca, Valle, and Antioquia. KERNAN has explored the wild regions east of Ocaña, and Norte de Santander, and the slopes of the Sierra Nevada de Santa Marta. McCOMB has divided his time between northern Huila and northern Boyacá, and will later explore the eastern slope of the central cordillera west and south of Ibagué, in Tolima. JONES worked in western and central Boyacá. LITTLE will have, by the time he has completed his work, a thorough knowledge of Huila and the adjacent portions of Meta and Caquetá. FASSETT has concentrated mainly on the region between Vélez and San Vicente in western Santander, studying *Remijia pedunculata* and its relatives, in addition to the *Cinchona* species of the area. He will shortly continue his work in the Pamplona and Cúcuta areas of Norte de Santander. GRANT has concentrated on Cundinamarca and adjacent Meta. ST. JOHN is working in the parts of Santander west, north and east of Bucaramanga, and will later work on the western slopes of the central cordillera in Caldas and Valle. EWAN traveled with CORE in Antioquia, and, after a bout with tropical public enemy No. 1, malaria, he is new exploring the mountains of Nariño and western Putumayo.

*Cinchona* is mainly a mountain genus, extending, in Colombia, from 1,500 to 3,000 meters altitude, in temperate mountain rain-forests, in the roughest kind of country imaginable. The *Cinchona* explorer, though working in the tropics, seldom has to endure the traditional sticky heat of the torrid zone, but is much more likely to encounter cold and continuous rain, muddy and almost impassable trails, back-breaking climbs, bad food, and occasional unreliable guides. When studying *Remijia,* which occurs from 100 to 1,500 meters altitude, to these difficulties are added insects as well as malaria and other diseases.

In addition to the exploration work, another botanical project under way is an anatomical study of *Cinchona* and related barks and of other barks mistaken for or used to adulterate *Cinchona.* This work is being ably done by Mrs. RUBY RICE LITTLE. It is expected that, correlated with the analytical work by Mr. TOM BELLIS and my own taxonomic studies, valuable light may be shed on the botany of the genus *Cinchona* as well as results of enormous practical value in the program of bark exploitation.

It is to be hoped that the greater part of our exploratory work will be finished by the end of the year and that at least some of us will be able to return to our normal activities.

FOREIGN ECONOMIC ADMINISTRATION,
BOGOTÁ, COLOMBIA.

WILLIAM C. STEERE*: **The Work of the Botanists of the Cinchona Mission in Ecuador:** — The botanical work of the *Cinchona*-bark procurement mission in Ecuador has had unexpected success, because of the coöperation of the highly capable and compatible group of botanists. The sympathetic attitude of the director of the Mission,

* Senior Botanist, Foreign Economic Administration, Oct. 1, 1942-Dec. 4, 1944. Received Nov. 1944.

Dr. F. G. RAINEY, a professional anthropologist, already familiar with the methods and the outlook of scientific men, also contributed much to the success of our work.

The search for quinine-producing barks in Ecuador was started under the auspices of the American Quinine Company by Dr. JULIAN A. STEYERMARK of Field Museum, who arrived in Ecuador in the spring of 1943 and left for Venezuela in November of the same year. His botanical expeditions were primarily in the southernmost provinces: El Oro, Loja, and Azuay. In July, 1943, I was sent to Ecuador as the first botanist employed there by the U. S. Board of Economic Warfare (now the Foreign Economic Administration), after having been engaged in *Cinchona* exploration in Colombia since November, 1942. My first expeditions in Ecuador were in the northernmost provinces — Napo-Pastaza, Carchi, and Imbabura — exploring especially for *Cinchona pitayensis* Wedd., a high-yielding species with which I had worked in southern Colombia. My search was successful, and *C. pitayensis,* previously unknown in Ecuador, has now been followed southward in the western range of the Andes from the Colombian frontier to latitudes south of Quito, and into the southern hemisphere. I made less extensive surveys in the provinces of Pichincha, León, Tungarahua, and the Oriente. The last months of my work in Ecuador, before my final departure in September, 1944, were largely spent in administrative work in Quito, unfortunately at the expense of botanical exploration. In September, 1943, Dr. WILLIAM B. DREW of the University of Missouri arrived in Ecuador as the first of a series of competent men sent by the B.E.W. (and F.E.A.) with the classification of Botanist. His first expedition was in the province of Loja, but as *Cinchona pitayensis* became increasingly important in the northern provinces, he left Loja for a joint trip in the province of Imbabura with Dr. F. MARION OWNBEY and myself, after which he remained in Imbabura for many months. Dr. OWNBEY, of the State College of Washington, had arrived in November, 1943. After his second expedition, a lengthy survey of the headwaters of the Río Napo, bad health forced him to return in March, 1944, to the United States. Dr. W. H. CAMP of the New York Botanical Garden arrived in Ecuador late in April, 1944, and almost at once entered the field, jointly with myself, in an exploration of the valley of the Río Pastaza, between Baños and Puyo. In May, 1944, Dr. GERALD W. PRESCOTT of Albion College, and Dr. IRA L. WIGGINS of Stanford University arrived in Ecuador. Their first expeditions consisted of separate explorations for *Cinchona pitayensis* in the province of Imbabura; Dr. PRESCOTT in the company of Dr. B. F. WALLIS, a geologist with some 20 years' experience in the wilds of Ecuador, and Dr. WIGGINS in the company of Dr. DREW. Dr. DREW has continued his botanical work in Imbabura province, Dr. CAMP has been stationed in the provinces of Loja and Azuay since late May, 1944, Dr. PRESCOTT has explored (successfully) the province of Pichincha for *Cinchona pitayensis,* and Dr. WIGGINS has been assigned the practically unknown province of Cañar to explore. We gratefully acknowledge the surveys made in our behalf by the Ecuadorian botanist, Dr. M. ACOSTA-SOLÍS, in the provinces of Bolívar, Loja, Chimborazo, and Pichincha.

As the result of our successful explorations for new *Cinchona* stands, we have discovered several unexpected species. The discovery of *C. pitayensis,* already noted, added a new bark source of great value, and very recently CAMP has turned up *C. lucumaefolia* Pav., *C. microphylla* Pav., and *C. nitida* R. & P., all from the Loja zone. Unfortunately, the economic value of these species new to Ecuador, both in alkaloid content and in quantity available, has still not been determined. *Cinchona pubescens* Vahl, although not particularly rich in alkaloids, has now been found to occur throughout the Ecuadorian Andes, and *C. officinalis* L., not previously known to occur in Ecuador north of Loja and Azuay, has been found to extend northward in the eastern range of the Andes completely to the Colombian frontier. We have collected still other species which cannot yet be identified, but which will certainly represent species new to Ecuador, if not to science. In addition to our detailed field studies on *Cinchona,* CAMP, DREW, PRESCOTT, WIGGINS, and I have made the collection of all other *Rubiaceae,* especially the genera more closely related to *Cinchona,* an integral part of our expeditionary work. Furthermore, each man has found incidental opportunities to collect various other plants of especial interest to him, and notable collections have resulted, as follows: *Ericaceae* and *Lycopodium* by CAMP; *Orchidaceae* by DREW; *Algae* by PRESCOTT; *Rubiaceae* and *Bryophyta* by STEERE; the general flora by

STEYERMARK; and *Pteridophyta* by WIGGINS. The botanical results of our explorations, then, are important and will add substantially to the present knowledge of the botany of Ecuador.

As an illustration of the incredible richness of the Ecuadorian flora, I may cite my experience with the *Rubiaceae.* Out of the 345 numbers which I had collected in the course of my work, Dr. PAUL C. STANDLEY has already identified some 150 species, of which he has tentatively named 56 as new. My field observations convince me that intensive collecting in any other large family would be just as productive.

The following publications concerning our botanical work have already appeared: ACOSTA-SOLÍS, M. "Botánicos que estudian la flora ecuatoriana." Flora (Revista Inst. Ecuat. Cienc. Nat.) 3: 235-247, 1943; STEERE, W. C. "*Joosia pulcherrima,* una nueva especie ecuatoriana de Rubiacea, genero nuevo para el Ecuador." *Ibid.* 3: 195-198, 1943; "El descubrimiento y distribución de la *Cinchona pitayensis* en el Ecuador". *Ibid.* 4: 1-9, 1944; and "The botanical work of the Cinchona missions in South America." Science 101: 177-178, 1945; A report of some recent collections of *Rubiaceae* from Ecuador. Bull. Torrey Bot. Club 72: 295-311, 1945. — The botanical results of our work may be expected to be published through several years, and the ultimate record will show not only the satisfactory accomplishment of the basic objective, of great necessity during the war emergency, but also a promotion of international cultural and scientific relations which has accrued as a byproduct of the emergency. It may be pointed out that the accurate mapping and delimitation of the *Cinchona* species which has been done will be a necessary basis for intelligent prosecution of work in plant breeding and introduction which may be done in the future.

It has been a privilege indeed to work with CAMP, DREW, PRESCOTT, and WIGGINS, who in the face of arduous and hazardous field conditions, and even while suffering from illnesses, have carried on work so essential to the Allied war effort.

DEPT. OF BOTANY,
UNIVERSITY OF MICHIGAN,
ANN ARBOR, MICH., U. S. A.

RICHARD EVANS SCHULTES: — **Glimpses of the little known Apaporis River in Colombia:** — Early in 1943*, JULES DE WAEL MAYER, Esq., Special Representative of the Rubber Development Corporation in Bogotá, commissioned me to explore the Apaporis River Basin in eastern Colombia. The purposes of this study were: *1.* to determine the species, distribution, abundance, and commercial exploitability of *Hevea* and other lactiferous plants; and *2.* to map the river and report on its navigability.

In connexion with this exploration, I found it possible to make a cursory examination of the general flora and a very limited collection of plants from the Upper Basin. I deeply regret that it was impossible to make a larger and more representative collection. In the Middle and Lower Basins, no collections were made; and, in the Upper, only some 350 numbers. Carried out at the cost of a life and innumerable difficulties imposed by distance, inaccessibility, absence of population, treacherous rapids and falls, this trip had as its chief purpose tasks so time-consuming that extensive botanical collecting was out of the realm of feasibility. A very preliminary examination of the small collection, however, has brought to light so many new or rare plants that we can say without fear of exaggeration that it is imperative that a thorough botanical survey of the Apaporis drainage be made. Only with an understanding of the flora of the Apaporis can we hope to arrive at an accurate understanding of the composition, distribution, and history of the western Amazonian flora.

The explorations were carried out from April to October, 1943, and in January, 1944. During the early part of the work, I enjoyed the invaluable collaboration of EVERETT L. VINTON, Esq., forester, Field Technician for the Rubber Development Corporation. In July, CARL O. GRASSL, Esq., of the United States Department of Agriculture, spent several days with me in the mountains of the Upper Basin. In January, 1944, I visited these mountains again and was accompanied by Señor GABRIEL GUTTIEREZ of the Instituto de Ciencias Naturales, Bogotá, who made an excellent collection of 70 numbers.

The Apaporis River, navigable (with numerous interruptions) for more than 2100 kilometers, is believed to arise in the Mesa de Pardaos, Intendencia del Meta. It

* At this time, I was serving the Rubber Development Corporation as Field Technician.

empties into the Caquetá or Japurá at the Colombo-Brazilian border. From its source to its confluence with the Macaya River (some 300 kilometers), it is called the Ajaju; only below the Macaya does the name Apaporis apply. Solitary, uninhabited, meandering first through flat mesa-like grasslands, then twisting between grotesque mountains, finally scouring its way through flat, unbroken Amazonian jungle with many picturesque rapids and cascades ("cachiveras") and forming, in its last few kilometers, part of the Colombo-Brazilian boundary, the Apaporis is one of the mightiest and certainly the most majestic Colombian affluent of the Amazon.

For convenience, and purely arbitrarily, I divide the Apaporis into three parts: Upper, Middle and Lower Basins. I. The upper Basin, by far the most critically interesting botanically and geologically, includes the Ajaju (with its sole affluent, the Yaya), the Macaya, the Majaya, and the upper fifty kilometers of the Apaporis proper. This stretch is interrupted by the long series of rapids known collectively by the name Cachivera de Chiribiquete. II. The Middle Basin, an uninterrupted, easily navigable stretch of 500 kilometers (with the Tacunema, Pacoa, Macayarí, and Cananarí as its affluents) from the Cachivera de Chiribiquete to the great falls and rapids of Jerijerimo. III. The Lower Basin, from Jerijerimo to the Caquetá, a stretch repeatedly interrupted by extraordinarily beautiful but treacherous rapids (and receiving the large affluents Popeyacá, Piraparaná, and Taraíra).

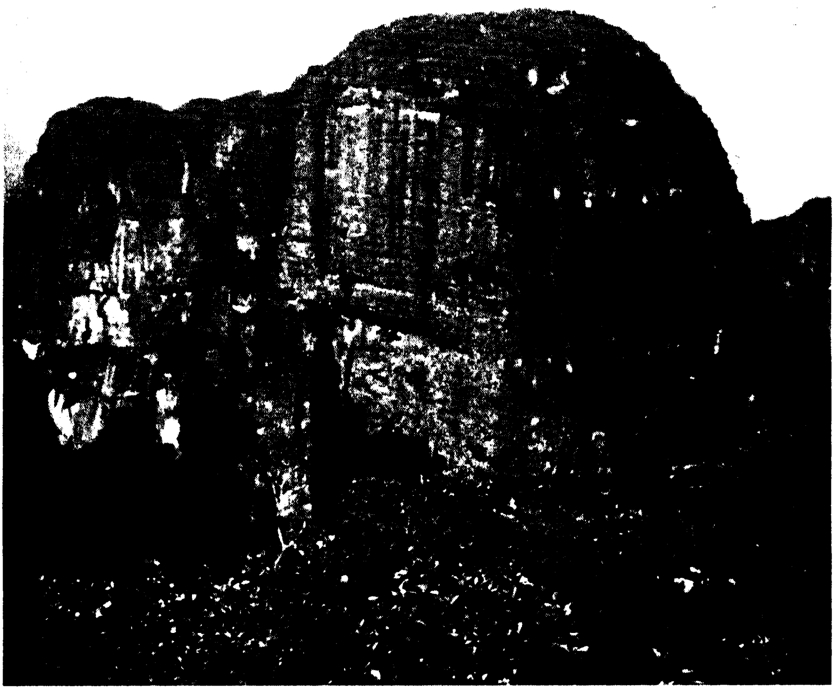
The Upper Basin, consisting of a sandstone base and laterite gravel, is characterized by numerous isolated, sandstone mountains. The region abounds in rills, brooks, and creeks of crystalline water. One searches in vain for the muddy waters heavily charged with suspended yellow clay, so common in other parts of the Amazonian drainage. A number of the creeks pour forth the so-called "black-water," strangely brown-tinted with tannins from rotting vegetation. The mountains are of two forms: either *1.* long, flat-topped, tilted ridges with one face (usually the northeastern) in the form of a cliff surmounted on two or three jutting strata which provide extensive flat shelves, the other face gently and gradually sloping to the forest floor; or *2.* knob- or dome-shaped elevations with perpendicular cliffs on all sides, often grotesquely eroded and often with deep fissures and faults, and surmounted at the base with broad, flat sandstone shelves. All of these mountains in the Upper Basin are of approximately the same height, ranging between 800 and 1200 feet above the forest floor or 1700 and 2100 feet above sea-level. The quarzite of these mountains, with its general red-brown or yellow-brown hue, varied here and there with brilliant streaks of red and green, presents a pleasing picture. The traveller can often see from great distances, slender and ribbon-like against the coloured cliffs, graceful cascades. The lower parts of the Ajaju and Macaya bore their way through these mountains which, arising abruptly out of the vast carpet of unbroken jungle in irregular fashion, are suggestive of scenic reconstructions of long-gone geologic ages. When we know more of the curious flora of these hills, it may perhaps be learned that they are the repositories of many old and ancestral forms of plants which, finding the luxurious environment of the river basin below more congenial, evolved and differentiated into varieties and species more complex or more advanced.

Peculiar ecological conditions prevail on these mountains, and their flora varies most strikingly from that of the surrounding jungle. The summits, flat extensions of sandstone periodically washed by cloud-bursts, are nearly devoid of soil. Here and there are pockets or depressions where accumulations of sand lodge. On the exposures, the flora comprises grasslands or "savannas" or a dense brush of low, gnarled shrubs. It is difficult to picture the extreme conditions of drought existing on these dry islands set in the midst of the notoriously humid Amazonian basin. Due to psammophytic or chersophytic conditions, drought prevails, even in the rainy season. In the small cracks and depressions where water does collect, physiological drought, without doubt caused by acidic or mineral constituents, is in evidence. During the height of the dry season, when no rain may fall for a month and a hot sun bakes the rock substratum, actual drought due to lack of water prevails. From April through June, a curtain of thick mist drops over the hills every evening. I have camped in this mist and have found that it drenches everything as thoroughly as would a light rain. But the next morning, the sun disperses the mist, and the vegetation is exposed, without the slightest protection, to the most intense heat and radiation. In the dry season, this mist-cover is not so dense and, in the driest months, is lacking altogether.

It is obvious, then, that only those plants of a highly xerophytic nature can sur-

**EXPLORING THE APAPORIS RIVER IN COLOMBIA I**

The flat sandstone summit of Cerro, Chiribiquete at the confluence of the Ajaju and Macaya Rivers (photograph by R. E. SCHULTES).



**EXPLORING THE APAPORIS RIVER IN COLOMBIA II**

One of the several dome-like sandstone masses which collectively are known as the Cerros de la Campaña, on the Ajaju River (photograph R. E. Schultes).

vive conditions of such drought. One can find all kinds of xerophytic adaptations on the hills. All plants are reduced in size. Many species have glossy, leathery or fleshy leaves, sometimes with waxes. Others have leaves the position of which is strongly reclinate. Still others fold, collapse, or completely close up their leaves. Petioles are frequently foreshortened and thickened. Barks are commonly thick and suberous, or thin and coated with wax. Epiphytic forms with enormously exaggerated pseudobulbs and much-contracted rosette-forms are abundant. Many species are highly resinous. Roots are exceptionally well developed.

These summits and the flat, jutting shelves of the hills are clothed with patches of low, herbaceous plants, the most notable of which are several interesting primitive ferns (*Schizaea* and others); numerous species of grasses and sedges; a number of bromeliads (*Navia acaulis, N. Schultesiana, Pitcairnia* sp.); a surprising variety of *Orchidaceae* (including *Bifrenaria sabulosa, Epidendrum caespitosum, E. nocturnum, Habenaria heptadactyla, Sobralia, Schomburgkia,* etc.). The bushy species which grow, sometimes isolated, sometimes in dense tangles, include: several species of *Clusia;* a red-flowering *Calliandra;* a stubby, abbreviated shrub which is probably an undescribed species of *Vellozia* of the *Velloziaceae; Ficus chiribiquetensis; Ternstroemia* sp.; a beautiful shrubby, white-flowered *Plumeria;* the extraordinary *Bombax coriaceum;* a shrubby, leathery-leaved *Stifftia;* a small, bushy variety of *Hevea viridis;* the low, abundant *Senefeldera chiribiquetensis;* an extremely fragrant, white-flowered rubiaceous bush; a leathery-leaved *Cassia*-relative; and numerous other less noticeable species. In localized dips and depressions, where sediments (and, in the rainy season, water) can accumulate, myriads of minute individuals of a yellow *Utricularia* and a purplish *Polygala;* several interesting juncaceous and xyridaceous species; and many clumps of *Paepalanthus* spp., are found. In amongst grasses and sedges, burmanniaceous (*Apteria* and *Dictyostegia* spp.) and gentianaceous (*Leiphaimos*) root-parasites abound.

The mountains of the Upper Basin are apparently a part of the interrupted range that "begins" at La Chorrera (Río Igaraparaná) and Araracuara (Río Caquetá) and stretches across the Comisarías del Caquetá and Vaupes in Colombia, the valley of the Río Negro in Brazil, and on into southern Venezuela and the Guianas. We do not have botanical material from many of these hills. The mountains of the Upper Apaporis represent the westernmost extent of this interrupted range, unless the botanically unknown Macarena, south of San Martín, should prove to be a part of the same range.

Although our knowledge of the floras of the hills of these ranges is very sporadic and incomplete, we have enough data on several widely separated hills in Colombia to say that each one has certain peculiarities. Each has its endemics, and each has its widely distributed forms. The interesting collection (1943) of PAUL H. ALLEN, Esq.,[1] on the savanna of Cuduyarí, an affluent of the Lower Vaupes River, indicates that the characteristic plants are, in part, palms which are absent on Cerros Chiribiquete and Campana in the Upper Apaporis: *Mauritia Carana, Mauritiella aculeata, Parascheelia* sp., and others. The collections of JOSÉ CUATRECASAS (1939) and of myself (1944) on Cerro Circasia, Lower Vaupes, establish the similarity of the savanna flora of this locality to that of Cuduyarí. When I visited (1944) the high, sandstone plateau of Araracuara (type locality of a number of MARTIUS' plants), I saw that the flora was more like that of Circasia than that of Chiribiquete, but that Araracuara has species (*e.g.,* the extremely abundant *Schoenocephalium Martianum*) not found on the other two hills. On all of these savannas, however, one can find the curious *Hevea viridis* var. *toxicodendroides,* but not in the abundance of Chiribiquete; at Araracuara and Circasia, it is rare. Apparently, the same undescribed species of *Vellozia* exists on far-separated Chiribiquete and Cuduyarí, but the former has certain very striking endemics such as *Ficus chiribiquetensis, Senefeldera chiribiquetensis, Navia Schultesiana* and others which have never been seen outside of the Upper Apaporis. It is interesting to note in passing that the flora of Cerro de la Pedrera, on the Caquetá River near the mouth of the Apaporis, is completely different from that of the other mountains of eastern Colombia.

It is my belief that these hills are repositories for a number of primitive plants. Many species of Amazonian plants are known to have been extended by water and to have had their origins on or near the highlands at the headwaters of the important affluents. It is striking to follow the distribution of various species by river-

[1] *Cf.* ALLEN, P. H. *in* Mo. Bot. Gard. Bull. 22(1944)50.

systems. We may cite: many palms, *Cecropia, Ficus, Hevea, Paullinia, Serjania,* and *Vochysia,* to name only a few groups which follow river systems. With further studies of the floras of these sandstone hilltops, we may be able more accurately to appreciate the history of many species. One example will serve for the present. The hills of the Upper Apaporis are very densely populated with the small, shrubby, xerophytic variety *toxicodendroides* of *Hevea viridis.* As one goes eastward in Colombia, this shrub appears to be less abundant on the hills. But, in the rocky swamps or "igapós" of far eastern Colombia, the huge and more advanced *Hevea viridis* becomes increasingly abundant. I believe that *Hevea viridis* var. *toxicodendroides* represents a very primitive stock of this genus. It is obviously *not* the parent stock, but it is by far the most primitive form yet known with the possible exception of the very poorly understood and, in habit, similar *Hevea camporum* of the hills of the Upper Madeira River in Brazil.

The forest of the Upper Apaporis Basin floor does not differ markedly from the jungles of the Vaupes Basin. Between the composition of the forest of the Upper and Lower Apaporis Basins there is a gradual, almost imperceptible change, but there is nothing of sufficient importance to discuss in the present short article. In general the Upper Basin has more species of "tierra firme"; the Lower has many swamp species. To the rapid traveller, the preponderance of representatives of the *Leguminosae, Palmae,* and *Euphorbiaceae* is at once apparent. The abundance of *Araceae, Bombacaceae, Moraceae, Sapotaceae,* and *Vochysiaceae* is likewise striking. Notably absent or rare are species of *Boraginaceae, Compositae, Gramineae, Orchidaceae, Rosaceae, Rutaceae, Scrophulariaceae,* etc. Overlooking ferns, tree-ferns and many herbaceous genera, we may note the following important groups which compose the Apaporis jungle: *Guatteria* and other genera (*Annonaceae*); *Couma, Neocouma,* etc. (*Apocynaceae*); *Anthurium,* etc. (*Araceae*); numerous bignoniaceous groups, especially trees of *Jacaranda*; the gigantic *Bombax* and *Ceiba,* as well as *Matisia* and, in clearings, *Ochroma* (*Bombacaceae*); numerous bromeliaceous epiphytes; several interesting climbing cactaceous epiphytes related to *Epiphyllum* or similar genera; *Cochlospermum* (*Cochlospermaceae*); a large number of species of *Carludovica* and *Cyclanthus* (*Cyclanthaceae*); the abundant *Hevea,* as well as *Micrandra, Phyllanthus, Sapium,* and (in the Lower Basin only) *Cunuria* (*Euphorbiaceae*); many epiphytic *Gesneriaceae*; *Clusia* (*Guttiferae*); *Nectandra* and possibly other lauraceous genera; *Grias* and *Lecythis* (*Lecythidaceae*); *Albizzia, Brownea, Copaifera, Coumarouna, Erythrina, Inga, Lonchocarpus, Mimosa, Ormosia, Pseudoacacia, Swartzia,* etc. (*Leguminosae*); *Strychnos* (*Loganiaceae*); a surprising number of ubiquitous loranthaceous parasites; colourful vines belonging to *Banisteria* or *Banisteriopsis* (*Malpighiaceae*); many melastomaceous genera, mostly low trees or shrubs; the valuable *Castilla,* abundant *Ficus, Cecropia* (curiously, *not common* in this river basin), *Perebea, Piratinera* and other lesser genera (*Moraceae*); many *Heliconiae* (*Musaceae*), a few myrsinaceous genera; innumerable palms of *Astrocaryum, Bactris, Chamaedorea, Desmoncus, Euterpe, Jessenia, Mauritia, Mauritiella,* and many other interesting genera; many *Piper* species and a few *Peperomias* (*Piperaceae*); few *Rubiaceae*; showy vines of *Paullinia* and *Serjania* (*Sapindaceae*); gigantic trees and low shrubs of sapotaceous genera such as *Bumelia, Chrysophyllum, Manilkara, Oxythece,* etc.; interesting *Sterculiaceae* belonging to *Theobroma* and *Herrania;* a few tiliaceous plants; the water-vine of the *Vitaceae;* extraordinarily showy trees of *Vochysia* (*Vochysiaceae*); and others too numerous to consider here.

The opportunity has not yet presented itself for making a careful study of the small collection from the Apaporis. But, as stated above, the number of new or rare plants which a casual inspection has brought to light justifies our belief that the Apaporis and its affluents hold many botanical treasures. *Ficus ajajuensis,* from the uppermost reaches of the great Apaporis, shows relationships with a distant Brazilian species but is very distinct. *Ficus chiribiquetensis,* known only from the sandstone exposures of Cerro Chiribiquete, is a highly xerophytic, bushy species with no close allies.[2] A new species of the melastomaceous genus *Graffenrieda* remains to be described. The widespread *Hevea viridis* var. *toxicodendroides,* the type of which was collected on Cerro Chiribiquete, may, upon later and more comparative examination, appear to deserve specific distinction.[3] A gigantic highland form of *Hevea,* apparently

[2] *Cf.* Dugand, A. *in* Caldasia 9(1944)375.
[3] *Cf.* Schultes, R. E. *in* Caldasia 11(1944)25.

a variety of *H. guianensis,* was collected in rocky fissures at an altitude of 1500 feet above sea-level on Cerro del Castillo in the Upper Apaporis; unfortunately, flowering material is lacking. What seems to be a very small species of *Couma,* perhaps related to the Brazilian *C. catingae,* was seen on the wooded slopes of Cerro Chiribiquete. From numerous isolated colonies of what is probably a new species of *Mauritiella* were made several collections which are now being examined. The bromeliaceous *Navia Schultesiana,* growing in huge mats on the dry top of Cerro del Castillo, is an endemic of this small genus. The Upper Apaporis has yielded several very interesting new *Paullinias*: *P. emetica, P. splendida, P. splendida* fma. *chrysocarpa,* and P. *vaupesana* var. *macayana.*[4] The extraordinary, new *Senefeldera chiribiquetensis,* the most abundant shrub on the tops of the mountains of the Upper Basin (occurring in dense stands on Cerro de la Campana, 8000 per hektar!), represents an interesting endemic of this small euphorbiaceous genus. A curious, lily-flowered species of *Vellozia,* common on Cerro Chiribiquete, has yet to be described. At least two very reduced new species of *Clusia* were collected. Several possible novelties in ferns, a new species of diminutive grass, and what is perhaps a new variety of a Vaupes species of *Oxythece* await attention.

As the collection is studied, we expect to find a number of specimens of plants which Martius found on Araracuara and other standstone areas in southeastern Colombia more than a century ago. One example can be presented here, namely the extraordinary *Bombax coriaceum* which I found on Chiribiquete in May, 1943, and later collected at the same locality in July and in January, 1944 — all collections in various stages of fruiting.[5] Allen found it in flower on Cuduyarí in November, 1943, establishing its existence far to the east of its type locality at Araracuara. This species, belonging to a genus noted for its forest giants, is a low, prostrate shrub only two to four feet tall and occurs in abundance on the most sterile sandy and rocky exposures where little or no soil accumulates. Apparently it had not been collected since Martius found it over a century ago.

It is likewise probable that our list of *plantae colombiae* will grow very appreciably when the Apaporis is systematically studied. Many of its species show definite affinities with Brazilian species, especially those of the Río Negro valley. This is shown in any number of plant groups, but perhaps the most interesting to cite here in passing are the species of *Vochysia, Hevea,* a number of ferns, *Ficus,* and certain orchids (such as *Bifrennaria sabulosa, Epidendrum caespitosum*) and others.

In closing, it might be of interest to outline the distribution of species of *Hevea* in the Apaporis Basin. By far the most abundant, especially in the Upper and Middle Basins, on the high, sandy banks which are not subjected to annual flooding, is *Hevea lutea.*[6] Less frequent and coexistent with *lutea* is *Hevea guianensis.* Whereas, in the Upper Basin, *Hevea Benthamiana* is not very frequent, it is the dominant species of the low, floodable river banks of the Lower Basin. In the Lower Basin, *Hevea lutea* is found in the hinterland, that is, on the higher, sandy mesas at the headwaters of small creeks. *Hevea viridis* is exceedingly abundant at certain localities in the Middle, but, more especially, in the Lower Basin where rock outcrops are frequent. It becomes a very tall and corpulent tree, especially in *Mauritia*-swamps, but is generally met as a medium-sized tree on sterile, sandy soil. It is exceptionally abundant in the vicinity of the Cachivera de Jerijerimo. *Hevea viridis* var. *toxicodendroides* is known to occur only in the mountains of the Upper Basin, but it is a widespread plant in eastern Colombia, and further search in the Middle and Lower Basins might uncover it there. *Hevea pauciflora* was not found in the Apaporis, but it could be expected to occur in the Lower Basin.

The regions with floras most closely related to that of the Apaporis are: the Vaupes, the Yarí and Mesaí, the Miritiparaná in Colombia, and the Río Negro valley in Brazil. Of these, only the Vaupes and Río Negro are at all well known. I collected a very few plants in the Miritiparaná in 1944. But the great tableland over which the Yarí and the Mesaí flow before falling south towards Araracuara are completely unknown to botanists.

Harvard Botanical Museum
Cambridge, Mass.

Leticia, Colombia, *July, 1944.*

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[4] *Cf.* Schultes, R. E. *in* Caldasia 10(1944)419.
[5] *Cf.* Dugand, A. *in* Caldasia 8(1943)298; 10(1944)435.
[6] I expect to consider this as a variety of *Hevea guianensis* in a study shortly to be published.

circumstance that thiocyanogen does not, as supposed, add stoichiometrically to fatty acids and their esters and glycerides. Accurate analyses, based upon empirical thiocyanogen values, have since been made of samples of linseed and soybean oils, but new and correct analyses have yet to be reported on many drying oils of present and potential importance, including perilla oil, hempseed oil, chia seed oil, wheat germ oil, candlenut oil, walnut oil, stillingia oil, and rubberseed oil.

The establishment of the thiocyanogenometric method on an accurate basis may be expected not only to provide more accurate analyses of natural oils, but also to facilitate hydrogenation research, phase investigations, and other investigations involving the fractionation or alteration in composition of fatty materials. Very recently an optical method (8) has been developed, for the estimation of linoleic and linolenic acids, which depends upon the alkali isomerization of these to conjugated acids that absorb strongly in the ultraviolet region. This method should prove useful in investigations of such phenomena as rancidification and flavor reversion, where traces of linolenic or other highly unsaturated fatty acids are to be detected.

*The preservation of edible fats.* — A long-standing and troublesome problem in the technology of edible fats and oils is the preservation of these perishable materials. The spoilage of fats is the source of much annoyance and economic loss in the case of stored or packaged products such as salad and cooking oils, lard, shortenings, butter, and margarine, and is an even more serious matter in processed foods containing much fat, including crackers, biscuits, wafers, potato chips, and roasted nuts. Spoilage and deterioration in fats is different from that occurring in most other food products in that microorganisms are seldom involved. The development of unpleasant or rancid flavors and odors in fats is generally the result of atmospheric oxidation.

Since points for the addition of oxygen are provided by the double bonds in the fatty acid chains, the most obvious of the factors that determine the predisposition of an edible fat to deterioration is its content of double bonds, or its degree of unsaturation. There are, however, very great differences in the stabilities of fats that are equally unsaturated. It has long been recognized that these differences are occasioned by the widespread occurrence in natural fats of minute amounts of nonglyceride substances which function as antioxidants. The unsaturation of ordinary fats and oils cannot be reduced to a very low value by hydrogenation or other processing technique without causing the fat to become excessively hard and high-melting. The food processor is limited, therefore, in his ability to reduce the capacity of his fat products to absorb oxygen, and much of the recent chemistry and technology of fat preservation has been concerned with the inhibition of oxidation through the use of antioxidants.

The fundamental principles governing antioxidant action were established in the period between 1920 and 1930 through the work of MOUREU and DUFRAISSE (9) on a variety of auto-oxidizable materials other than fats, and that of CHRISTIANSEN (10), of BODENSTEIN (11), and of others associated with the development of the so-called chain-reaction theory. Most of the present knowledge of natural fat antioxidants derives, however, from the investigations initiated by MATTILL at the University of Iowa about 1931 and carried forward to the present with the collaboration of OLCOTT, GOLUMBIC, and others. A class of unsaponifiable antioxidants universally present in vegetable oils were termed inhibitols by OLCOTT and MATTILL (12). Subsequently, the inhibitols were demonstrated by OLCOTT and EMERSON (13) to be identical with the tocopherols (vitamin E), which had been discovered and chemically characterized by EVANS and coworkers (14). The work of GOLUMBIC and MATTILL (15) and of GOLUMBIC (16) established the important fact that ascorbic acid and other acid antioxidants are active only in conjunction with tocopherols, and suggested a probable mechanism for the synergism between these two classes of antioxidants. Furthermore, it was suggested by SWIFT, ROSE, and JAMIESON (17) and by GOLUMBIC (18), and confirmed in detail by BAILEY, OLIVER, and coworkers (19), that there is an optimum level at which the tocopherols are most effective. This level corresponds closely to their natural concentration in vegetable oils. Above this optimum level of concentration, tocopherols actually function as pro-oxidants, each successive increment of added tocopherols operating to further diminish the stability of the substrate.

While the above detailed research has served to identify and characterize chemically the probably most important class of vegetable oil antioxidants, and has revealed some

information concerning the manner in which they function, many puzzling questions remain unanswered. There are unexplainable discrepancies between the stabilities and tocopherol contents of similar oils. The demonstration that tocopherols may under proper circumstances accelerate the oxidation of oils renders uncertain the true distinction between natural antioxidants and pro-oxidants; and there is evidence (19) that the stability of a natural oil may be determined by the balance existing between the effect of chemically similar compounds of which some inhibit and others favor the absorption of oxygen. Certain oils, notably sesame and rice-bran oils, undoubtedly contain powerful and still unidentified antioxidants other than tocopherols. There is as yet no logical explanation of the fact that oleo oil, which has an inconsiderable content of tocopherols, is strongly stabilized by commercial lecithin, an antioxidant of the acidic type.

The necessity created by the recent World War for preserving edible fats for long periods under adverse storage conditions has greatly stimulated interest in practicable antioxidants for addition to lard and other fats naturally deficient in these substances. Among the recently proposed materials of particular interest are esters of gallic acid (20), nordihydroguaiaretic acid (21), and fatty acid esters of ascorbic acids (22). Gum guaiac (23) has been successfully used for some years as a stabilizer for lard. The recent development of molecular distillation as a commercial process (24) has provided a possible means of recovering antioxidant concentrates from tocopherol-rich oils for the fortification of fats deficient in tocopherols.

While the chief interest thus far has been in natural sources of antioxidants, there is some reason to believe that the materials that will ultimately find general acceptance and use will be synthetic antioxidants, made up of molecules especially constructed to combine maximum antioxygenic activity with nontoxicity, thermal stability, and lack of color, flavor, or odor.

The complex mechanism of oxidation and rancidification in fats has continued to be the subject of intensive investigation. Of recent work in this field, that of FARMER and coworkers (25) is of particular interest and significance. FARMER has demonstrated that, in oils oxidized at ordinary atmospheric temperatures, the initial oxidation products consist not, as formerly supposed, of peroxides formed by the addition of oxygen at the double bonds, but of hydroperoxides which form by the addition of oxygen at the carbon atom adjacent to the double bond and leave the latter intact. The preservation of edible fats is at present hampered by insufficient knowledge of the oxidation reaction, and fundamental contributions in this field may be expected ultimately to attain great practical significance.

A current problem in edible fat deterioration of almost equal rank with rancidification is that of flavor reversion, which may be defined as the appearance of undesirable flavors in fats as a result of slight oxidation, of a degree far short of that required for true rancidification. Flavor reversion appears to be associated with the presence of linolenic acid, or other fatty acids with three or more double bonds, and is most troublesome in deodorized products made from marine oils, linseed oil, or soybean oil. Peculiarly, it is not eliminated by hydrogenation of these oils to a degree apparently adequate for the elimination of highly unsaturated acids. A solution of the problem of flavor reversion has been given particular urgency by the greatly increased production of soybean oil in the United States in recent years, coupled with the parallel diminution in supplies of cottonseed oil, a nonreverting oil. Intensive research on flavor reversion will undoubtedly be carried on during the next few years; the present scientific literature is almost completely barren of information on the subject. The economic rewards of successful research in this field will be large; the tendency of soybean oil to revert in flavor is specifically responsible for the present differential in price between soybean oil and cottonseed oil, amounting to approximately one cent per pound in favor of the latter.

*Fractionation of fatty materials.* — Since fats and oils consist of complex mixtures of glycerides, each glyceride in turn being mixed with respect to its constituent fatty acids, it is hardly to be expected that many fats and oils would naturally have compositions that are optimum for any particular use. Actually, the value and utility of many natural fats and fatty materials may be improved by subjecting the material to fractionation, in order to produce new products of more homogeneous composition.

Fractionation processes are old in the oil and fat industry, having been used for

many years in the production of winterized cottonseed oil, oleo oil, lard oil, cold-cleared fish oils, and commercial oleic and stearic acids. Quite recently new fractionation techniques have been introduced. These have resulted in the production of a number of new, so-called "tailor-made" oil and fat products, the introduction of which constitutes one of the most interesting recent developments in oil and fat technology. Fractionation processes may be expected to assume increasing importance in the future.

Fatty acid mixtures consisting of acids of different chain lengths may be resolved very efficiently by fractional distillation. In the case of fish oil fatty acids, fractionation according to chain length produces also a relatively good separation according to degree of unsaturation, since the saturated acids of these oils contain 16 and 18 carbon atoms, whereas the more highly unsaturated acids have chain lengths of 20 or more carbon atoms. The "Neofats", a series of fats and fatty acids prepared by fractional distillation, were introduced by Armour & Co. about 1936. The Neofats consist for the most part of fish oil products (26) intended for use as drying oils. However, they also provide in large quantities, for the first time, a series of saturated acids of reasonably high (90%) purity, ranging in molecular weight from caprylic acid to stearic acid.

A recent fractionation process, which has attracted much attention and promises to be highly useful, is that of liquid-liquid extraction. Developed independently by FREEMAN and coworkers (27) of the Pittsburgh Plate Glass Co. and by Goss and coworkers (28) at the Northern Regional Research Laboratory, this process has been considered most useful for the treatment of soybean and linseed oils for the improvement of their drying properties, but it undoubtedly has other applications.

Low-temperature fractional crystallization from solvents came into prominence as a method for the fractionation of fatty materials through the work of BROWN and coworkers (29), who demonstrated its efficacy in the preparation of unsaturated acids of high purity for laboratory investigation. Although this method of fractionation is not at present practiced on a commercial scale, it will undoubtedly find such use in the future, as it provides a means of not only improving present fractionation processes, but of also producing useful new products (30).

In discussing developments in fractionation techniques, mention should be made of the recent use of molecular distillation on a commercial scale, (24) for the production of vitamin A concentrates from fish oils and vitamin E (tocopherol) concentrates from vegetable oils. It has very recently been demonstrated (31) that tocopherol concentrates can also be prepared by low-temperature fractional crystallization of the oils. Certain liquid-liquid extraction processes are said to also be suitable for the preparation of concentrates of oil-soluble vitamins.

*Polymerized oil products.* — For a large class of products, including paints, varnishes, printing inks, and linoleum, fatty oils are suitable raw materials because of their ability to polymerize or "dry" to form durable and elastic films or coherent and resilient gels. The ability of an oil to polymerize is closely related to its degree of unsaturation; it is through the double bonds that polymerization takes place, generally accompanied by some degree of oxidation. Conjugated oils, such as tung oil, which have double-bonds in adjacent positions in the fatty acid chains, have exceptional properties with respect to polymerization, and are particularly prized for the manufacture of polymerized products.

Despite the fact that it has been the subject of much investigation and a more extensive literature than almost any other branch of fat technology, the mechanism of oxidation and polymerization in drying-oil systems remains in many respects obscure. However, there have recently been made available new experimental techniques and new methods of approach which will in all probability greatly extend scientific knowledge of polymerization phenomena in the near future. The development of the concept of "functionality" in polymerization, which may be credited to CAROTHERS (32) and to KIENLE and coworkers (33), and more particularly to BRADLEY (34) in its applicability to drying oils, has greatly clarified certain aspects of the phenomenon. New ultraviolet absorption methods for the estimation of conjugated double bonds in drying oils and drying-oil products (35) have proved extremely valuable in investigations of polymerization phenomena (36).

The past few years have witnessed developments in paint and varnish technology which have had far-reaching consequences in the industry. Particular progress has

been made in the formation of quick-drying coating materials of satisfactory durability and high decorative value, in which synthetic resins have replaced natural fossil resins to an ever-increasing extent. The augmented demand for conjugated oils for such products and cessation of tung oil exports from China as a result of world-wide war have resulted in a tremendous expansion in the industrial dehydration of castor oil for the production of an artificial conjugated oil. The dehydration treatment itself is relatively new, dating in its present form from the Ufer process (37), patented in 1931. Another process, the alkali isomerization process (38), for the manufacture of conjugated oils, in this case from linseed or other nonconjugated oils, has made its appearance on a commercial scale (39). Also of great interest at present are processes in the laboratory stage of development (40) for the catalytic isomerization of drying oils to the conjugated form. These would avoid the fat splitting and reesterification of fatty acids with glycerol — which are involved in the alkali isomerization process.

A new class of polymerizable fatty products of great potential importance consists of esters prepared by the esterification of drying oil fatty acids with pentaerythritol (41) or other polyhydric alcohols containing more hydroxyl groups than glycerol. By substituting a higher polyhydric alcohol for glycerol in such products, the functionality of the molecules is increased, with a consequent increase in the readiness with which polymerization occurs.

Two new high polymers developed recently by the Northern Regional Research Laboratory are worthy of special mention. One of these is "Norepol," a rubber-replacement material possessing elasticity, considerable tensile strength and abrasion resistance, and other rubber-like properties. The other is "Norelac," (42) an artificial lacquer-making material of unique properties, which is chemically a polyamide, being prepared by the reaction of polymerized fatty acids or their monoesters with ethylene diamine. These products are made from soybean or linseed oil fractions.

*The surface-activity of fat derivatives.* — Because of their particular molecular structure, fatty acids are preeminently suited for the manufacture of that class of products which may be grouped under the broad designation of surface-active materials. The most common surface-active material, ordinary soap, has been made and used by man for many centuries. Recently a wide variety of related materials have been made available. These have found wide use, in the home and in industry. Whether classed as detergents, wetting agents, or emulsifying agents, they all have in common the property of surface-activity, or the ability to modify the surface behaviour of liquids in which they are dissolved.

Although much of the recent research in this class of materials has been directed toward substances other than soap, there have been important contributions to the fundamental knowledge of this latter product, which despite the competition of other detergents, will probably continue indefinitely to hold first place in commercial importance in its field. Since the investigation of soaps and their behaviour is for the most part physical or physicochemical, progress in this field has to a considerable extent paralleled the development of apparatus and techniques for work in such fields as surface and interfacial tension, contact angles, conductivity and electrophoresis, and x-ray diffraction. The exploration of phase diagrams for systems of soap and water, and of soap, water, and electrolyte, was initiated by McBain and associates about 1920, and is still continuing. The practical importance of these phase investigations can hardly be exaggerated; they are generally credited with having transformed soapmaking from a difficult art to a true science; but they are still far from complete. The phase pattern of anhydrous soaps was worked out by Ferguson and associates (43) and Vold and coworkers (44) as recently as 1939. The existence of true hydrates in the form of soap crystals or curd fibers is still controversial. The wonderfully detailed and revealing photographs of sodium laurate soap fibers, obtained by Marton and coworkers (45) with the aid of the electron microscope, furnish one of the most spectacular examples of the application of this new research tool to the elucidation of the submicroscopic structure of a material.

A phase of the physical chemistry of soaps that has but lately been the subject of extensive investigation is the polymorphism of these materials. It has been demonstrated by Ferguson and coworkers (46) that both the sodium soaps of pure fatty acids and the ordinary bar soaps of commerce may exist in four distinct polymorphic

forms of widely different characteristics with respect to consistency, solubility, and ease of lathering. The polymorphism of soaps is of the greatest practical importance. There have appeared on the market new bar soaps whose manufacture requires close attention to operating conditions to secure the particular polymorphic form desired. Patents issued (47) to cover these manufacturing processes have been the subject of litigation involving very large sums of money. The new soap processes are among the most interesting and spectacular examples of the application of modern science to improve a very old product. Many of the operations in soapmaking are still relatively inefficient and tedious; future research in this field may be expected to produce other important innovations. Of particular interest in this connection are the new continuous saponification processes disclosed in the patents issued to MILLS (48) and to CLAYTON, THURMAN, and associates (49).

Research in nonsoap detergents, wetting agents, and emulsifying agents, including sulfated oils, alkyl sulfates, aliphatic sulfonates, alkyl-aryl sulfonates, quaternary ammonium compounds, partial esters of polyhydric alcohols, and chlorinated aliphatic esters, is at present extremely active. There is a very wide variety of active chemical groups available to the organic chemist for combination with fatty acid chains to produce such materials, and the diverse requirements of industry have produced a demand for them which insures that development in this field will continue long into the future.

The commercial exploitation of a new surface-active material often depends upon the development of manufacturing processes for the material itself, or for an intermediate, that are adaptable to large-scale operation. Among the significant recently introduced processes may be mentioned the catalytic hydrogenation process developed by ADKINS (50), by LAZIER (51), and by others for the production of saturated fatty alcohols, the lead-soap process of RICHARDSON and TAYLOR (52) for preparing unsaturated fatty alcohols, and the process introduced by RALSTON and other workers (53) of Armour & Co. for the manufacture of fatty nitriles. The development of new processing methods will undoubtedly serve to steadily extend the list of surface-active agents available at low cost and in large quantity.

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Harley H. Bartlett and E. H. Walker: **A Program of Botanical Collecting and Study for Servicemen:** — An informal program for interesting and assisting naturalists and prospective naturalists in the armed forces to collect scientific material and to study their surroundings is developing in several institutions in this country. The botanists have taken the lead and the Department of Botany at the University of

Michigan has recently published the first three numbers of a series of little pamphlets containing instructions for collecting and studying different groups of plants. These are being sent to servicemen on request. The zoologists, geologists and anthropologists expect to issue similar pamphlets as soon as they are sure that those on botany fill a real need. The Smithsonian Institution has issued a Field Collector's Manual in Natural History which is being sent to interested servicemen on request. This manual is serving the universities and colleges as well as the issuing institution, because of its free distribution to all service men and the Smithsonian's broad policy of coöperation by the exchange of material. Reports from New York indicate that the American Museum of Natural History is doing much to stimulate servicemen's activity in zoological collecting.

Besides issuing instructions the botanists are working as a very loosely organized and informal interinstitutional group to identify the servicemen's collections and to conduct a friendly and educational correspondence with the collectors. This group aims to include a specialist, professional or amateur, in each field of systematic botany and to find additional experts in both botany and other scientific fields, as the need requires and as opportunity permits. The program may eventually be hampered by the fewness in this country of specialists in the natural history of the Pacific region and eastern Asia, where most of the interested servicemen are located.

The percentage of naturalists among the servicemen is very small, probably not exceeding one in a thousand, but these few should be sought out and encouraged because of their prospective importance for America's scientific future. There was a shortage of scientists after the First World War and a consequent failure of this country to participate as it should have in many scientific fields. Germany remained definitely the leader in world-wide natural science. Especially in botany and zoology, sciences in which geographic aspects are all-important, publications of world-wide scope continued to be largely German in initiation and execution, even if there was international coöperation. A large part of this German leadership depended on the astonishing wealth of collections contributed for generations by German travelers, commercial representatives, consular officials, and missionaries throughout the world. In the geographic aspects of science only Great Britain was a serious rival, but her efforts were on an Empire rather than a world-wide basis.

At the beginning of the present war the United States had only one specialist whose interests covered most higher plant groups in the Far East and the western Pacific, namely the Philippine specialist Dr. E. D. MERRILL. It is too much to expect one man to cover in addition all of subtropical China, Indo-China, Burma, Siam, the East Indies, and all the other areas in the east where we have suddenly found ourselves with botanical interests, opportunities and obligations, even though he does it with astonishing competence. As for the world interests of our institutions, Harvard University has indeed taken an international attitude. The Smithsonian Institution has always had broad aspirations, but has had niggardly support. A dozen other museums, botanical gardens, and educational institutions have developed more or less notable foreign research programs, but the great majority have been exceedingly provincial.

If America takes a proper view of its responsibility for scientific leadership and if a trained personnel is to be available for the large number of scientific institutions which will need staff additions after the war, then we must see to it that earnest and talented servicemen have a chance to begin a career abroad or to continue there a career already begun. Their aspirations must not become war casualties. Thus the one-in-a-thousand is important out of proportion to his low percentage. Sponsors of army educational programs are chiefly or solely interested in the average "G. I.". We, who are linked together in this program, realize that even those who constitute the one-in-a-thousand will make a large total for us to take care of. Actually the percentage may be larger, because for each scientist or would-be scientist there are several others who will gladly help, just for the fun of it, or because of a desire to help some friend or to promote a worthy cause, even if it is not their special cause. These numerous helpers are being enlisted by the servicemen naturalists from among their own comrades, some of whom through this missionary activity in *partibus infidelium* may become converts, permanently addicted as professionals or amateurs to the absorbingly interesting work of collecting objects of natural history.

Each serviceman naturalist is being urged to exploit scientifically the place where

he finds himself. If he is a beginner, we shall give him close guidance by correspondence. More experienced men will need only occasional aid and advice. There is not a coral reef or an islet of the Pacific that does not offer some problem to an enterprising naturalist. Few will fail to be intrigued by the opportunity of becoming the best authority in the world on some bit of isolated land, and there is no place where something valuable to science may not be found.

More than once we have been acidly reminded that our men are "fully occupied in fighting a war", and that efforts to provide scientific education and training for them before the end of the war could be more usefully expended. True it is that many men have no leisure and that many can look forward to no career at all — just death in battle. But my correspondence shows that many servicemen find themselves for weeks or months in the backwashes of the tide of war, where the only conflict is with boredom, mosquitoes and disease. There is no strategic reason why such men should waste their time, but quite the contrary. If just one at each post saw the opportunity and organized his willing comrades, the future of the natural sciences in their geographic aspects would be transformed. Energetic world-wide collecting would at one and the same time build up research facilities in America to replace those destroyed in the theaters of war, educate American specialists to use them, and provide materials for the researches of the future generations of scientists from abroad who will depend upon America as we in the past have depended upon Europe.

We are recommending that general botanical collections be sent either to the Smithsonian Institution, for the attention of Dr. E. H. WALKER, or to the Arnold Arboretum, Jamaica Plain, Mass., for the attention of Dr. E. D. MERRILL. At these institutions the material will be named or forwarded to the appropriate consulting specialists. Duplicates will be distributed or retained in accordance with the collector's wishes and in the best interests of American botany. Collectors who retain sets for their own future studies should number the specimens in such a way that an intelligible report can be made to them. The principal specialists who have expressed willingness to participate in this serviceman's program are as follows:

AGNES CHASE, custodian of grasses in the U. S. National Herbarium, Smithsonian Institution, is naming all grasses except bamboos, which are being named by F. A. MCCLURE, Research Associate in the Smithsonian Institution. W. RANDOLPH TAYLOR, professor of botany at the University of Michigan, is handling all marine algae except diatoms. PAUL S. CONGER of the Section of Diatoms, U. S. National Museum, is dealing with the latter, the easiest of all organisms to collect, a fact little known even to most trained scientists. E. B. COPELAND at the herbarium of the University of California, and W. R. MAXON at the U. S. National Museum are naming ferns. E. B. MAINS, D. V. BAXTER and ALEXANDER H. SMITH at the University of Michigan and JOHN STEVENSON in the U. S. Department of Agriculture are handling all forms of fungi, and C. W. DODGE of the Missouri Botanical Garden will name certain lichens. E. B. BARTRAM, an independent worker in Bushkill, Pennsylvania, and W. C. STEERE at the University of Michigan divide the mosses, the first taking tropical collections, the latter the northern ones. MARGARET H. FULFORD of the Sullivant Moss Society is naming hepatics. T. G. YUNCKER of DePauw University receives all *Piperaceae,* and CHARLES SCHWEINFURTH of Harvard University the *Orchidaceae.* The senior author attempts to care for aroids, palms, and a few other odds and ends, and to answer miscellaneous questions.

Besides naming collections, some of the specialists are carrying on lively correspondence with servicemen, preparing articles for publication on their collections and writing pamphlets with instructions for further collecting. Other specialists will be added to the group of consultants as needed or as they volunteer to help in this interinstitutional and looseknit program. Inquirers and volunteers may address the senior author at the U. of Michigan, Dr. E. H. WALKER at the Smithsonian Institution, or Dr. E. D. MERRILL at the Arnold Arboretum, Jamaica Plain, Mass. The most generally available single publication that will be of use and value to interested individuals is: MERRILL, E. D., "Plant Life of the Pacific World," Macmillan Co., N. Y. (sales edition) or Infantry Journal, Washington, D. C. (servicemen's edition).

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L. B. Moore: **Marine Algae in Commerce, 1942-1944:** — Extensive investigations into algal products during the years 1942-1944 call for a brief supplement to the article on "War-Time Interest in Marine Algae" (Chron. Bot. 7 (8) : 406, 1943) which was written before Pearl Harbor.

It is obvious that the most valuable algal product is still agar, and under the stimulus of war shortage many countries have set themselves to become independent of Japanese supplies of this strategic material. Agar is of vital importance in the technique of many branches of plant science and of biology in general. Even when supplies were at their lowest ebb, consideration was given to the quantities required by *Drosophila* workers.

In South California the long-established agar industry based on *Gelidium cartilagineum* (not the problematical *G. corneum* previously mentioned) is being stepped up with a goal of 250,000 lb. annual output. As part of an extensive programme of experimental work, Tschudy and Sargent report good prospects for four species not previously considered agariferous (Science 97(2508) : 89, 1943). These include species of *Gigartina* which yield an agar-like substance when extracted with a calcium salt, a method that works also with *Ahnfeltia plicata* (apparently an important source of agar in Russia), and with *Gracilaria*. Reedman and Buckby (Can. Jour. Res. 21D: 348, 1943) have shown that Canadian *Chondrus crispus*, after brief extraction with hot water, yields a product which, when dried and redissolved, gives a jelly quite as strong as agar if 0.2 per cent potassium chloride is added. Gigartinas grow quickly (much faster, at least in New Zealand, than the agar weeds of the family *Gelidiaceae*) and for this reason they may come to be widely used as a source of commercial jellies for meat-canning, etc., where mineral additions are permissible.

C. K. Tseng's paper (Sci. Mon. 58: 24, 1944) is particularly welcome for its up-to-date statistics, and for its authoritative statements on the confused use of the term agar. The revised definition he offers excludes the carrageenin types of substance, but covers extracts made from some species of *Gracilaria*. He mentions erroneous records of *Gracilaria lichenoides* as an agarphyte, and these, along with the uncertainty of field identifications in the genus, have undoubtedly raised some false hopes.

Reports of investigation on *Gracilaria confervoides* in Queensland and New South Wales continue to appear (Fisheries Newsletter 2(3) : 10, 1943). Apparently this species is used directly in meat-canning in Australia, but no account has been seen of the production of commercial dry agar from it there. *G. confervoides* also forms the basis of recent work in North Carolina (Humm, Science 96(2488) : 230, 1942), in India (Bose *et al.*, Jour. Sci. & Ind. Res. Ind. 1(2) : 98, 1943), and in South Africa (Fox & Stephens, S. A. Jour. Sci. 39: 147, 1943; Isaac *et al.*, Nature 151 (3836) : 532, 1943). In South Africa also *Hypnea spicifera* (*Gigartinales*) and *Gelidium pristoides* yielded sub-standard agars, while *Suhria vittata* (*Gelidiales*) and *Caulacanthus ustulatus* (placed by Feldmann and Hamel under the heading "Incertae sedis") both gave good products but were not practical sources because of collecting difficulties. Previous work of Isaac provided information about the distribution and abundance of *Gelidium cartilagineum* on the shores of South Africa. The possibility of manufacture from *Eucheuma spinosum* (*Gigartinales*) in West Australia has been mentioned.

Commercial production of agar from *Pterocladia lucida* and *P. capillacea* began in New Zealand in July, 1943, on a basis of about 50 tons of raw material (dry) per annum. The *Pterocladia* agar is of very good colour and high gel strength. The smaller *Gelidium caulacantheum*, not yet being collected in quantity, also yields good agar, but local Gracilarias so far tested are less promising. Moore (N. Z. Jour. Sci. & Tech. 25 B: 183, 1944) describes the collecting, marketing, and processing of the pterocladias, and gives some account of their ecology under the headings of habitat, regeneration and growth rate, and reproduction. Cystocarpic, antheridial and tetrasporic plants are found throughout the year, with a great preponderance of tetrasporics, which in commercial samples of *P. lucida* usually exceed 50 per cent and may reach 90 per cent of the total. Small differences in the physical properties of the agar are apparently correlated with morphological features of the plants. Efforts are being made to delimit the taxonomic units responsible.

Scheffer (Fishery Market News 5(6) :1, 1943) includes agar amongst commercially important seaweed gums. He discusses its war-time importance and deals

also with carrageenin and algin, clearly indicating avenues of necessary research on seaweed gums. The cutting-off of European, especially French, supplies of *Chondrus crispus* from the United States has stimulated harvesting of the extensive "Irish Moss" beds of the Atlantic coasts of Canada and New England. Records of the depths to which these weeds grow, and the different grades assigned to "pulled" moss from about low tide level, and "raked" moss from several metres deep, raise again the question of the taxonomic relations of these plants.

WOHNUS (Cal. Fish & Game 28(4) : 199, 1942) shows that in this war the value of kelp lies in its organic constituents, especially the alginates. Amongst new uses he mentions alginates as ingredients of asphalt paints for steel plates and wires to prevent painted surfaces from adhering to each other, and as stabilizers in camouflage paints, and copper alginate as a dressing for canvas and burlap to prevent mildew. His paper contains useful records of changes in area of kelp beds in the La Jolla-San Diego region.

CHAPMAN'S discussion of the zonation of marine algae on the sea-shore (Proc. Linn. Soc. 154(3) : 239, 1943) gives some indication of the light that can be shed on fundamental ecological problems by observations made in the course of a survey undertaken for utilitarian purposes. On many coasts, as in Australia, regional surveys, quantitative at least as regards certain species, are in hand for the first time. Much useful information must emerge. As a small illustration the very strictly limited distribution of *Macrocystis* in the New Zealand region can be correlated with the influence of currents on these islands. It is to be hoped that such matters, whether of immediate commercial significance or not, will be permanently recorded.

On the systematic side, there is at present an unprecedented opportunity for a co-ordinated attack on the problems of the *Gelidiaceae* if workers in different countries will collaborate and make full use of bulk collections and the results of chemical and ecological investigations that are now available. This family, which on quite other grounds is considered sufficiently distinct to be referred to an order of its own, still seems to be the most important if not the only source of true agar, and a clear understanding of its contents would probably bring its own reward. Experience with *Pterocladia* on a comparatively limited stretch of coast suggests that BORNET might well have included the whole family under the epithet he applied to *Gelidium* when he called it "genre diabolique".

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D. A. JOHANSEN : **Classification of the Types of Angiospermic Embryo Development:** — Outside of a provisional scheme proposed by SCHNARF (1) there has thus far been no available method whereby the various manifestations of embryo development in the Angiosperms may be arranged according to a logical and easily understood procedure. The basis proposed by SCHNARF appears to have been generally overlooked by plant embryologists, despite the fact that it actually furnishes the clue to the proper classification of embryogenic types. There also appears to be widely prevalent a totally erroneous idea that there exists a so-called "typical dicotyledonous (or monocotyledonous) type," although such a type of embryogenic development has never actually been described for either the dicotyledons or monocotyledons. As a matter of fact, there is absolutely no fundamental difference between the two classical taxonomic groups of the Angiosperms in so far as the essential ontogeny of the proembryo is concerned.

The information provided by SCHNARF has been brought up to date in connection with another project (2) and it has thus been rendered possible to devise a logical basis for the classification of Angiospermic embryogenic types as far as they are known at the present moment. The fundamental bases on which the scheme is erected are three in number: (*1*) the plane of the first segmentation of the zygote; (*2*) the plane of the first division in the resulting terminal cell of the two-celled proembryo formed as a result of the preceding division when it is transverse, and (*3*) whether the basal cell of the two-celled proembryo contributes something or nothing to the construction of the embryo proper, as distinguished from the suspensor sensu stricto. The funda-

mental laws of embryogeny, as postulated by SOUÈGES (3) and elaborated by the writer (2), were also closely adhered to in the formulation of the scheme.

Six fundamental Types are recognized, and these may be described briefly by means of the following key:

First division of the zygote is longitudinal .......................................... Piperad Type
First division of the zygote is transverse.
The terminal cell of the two-celled proembryo divides by a longitudinal wall during the second cell generation.
The basal cell has no or only a minor part in the construction of the embryo proper. Onagrad Type
The basal and terminal cells both contribute, more or less equally, to the construction of the embryo proper.......................................................... Asterad Type
The terminal cell divides by a transverse wall during the second cell generation.
The basal cell has no essential part in the construction of the embryo proper.
The basal cell undergoes no further division and becomes a large suspensor cell (when a suspensor of two or more cells is formed, these are always derivatives of the terminal cell) ........................................................ Chenopodiad Type
The basal cell usually forms a suspensor of two or more cells................ Solanad Type
The basal cell contributes more or less to the construction of the embryo proper..............
Chenopodiad Type

The Onagrad Type is essentially the "Cruciferen-Typus" of SCHNARF, but, contrary to his supposition, the *Onagraceae* represent a more fundamental type than does the embryogeny of the *Brassicaceae* (*Cruciferae*). *Capsella*, so widely taken as a representative type of dicotyledonous embryogeny, is merely a variation of the Onagrad Type. The other types, excepting the Piperad Type, are identical with those of SCHNARF.

Under each Type there are from two to numerous subdivisions which are styled Variations. A Type is fundamental, whereas a Variation is based upon minor modifications of the basic Type.

Keys for the determination of the Variations are presented elsewhere (2). It is believed that the availability of a logical basis for the classification of the different procedures by which angiospermic embryos develop will place the whole field of plant embryology on a sounder basis and will stimulate the presentation of more accurate reports and diagnoses in future research investigations.

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*References:* —

1. SCHNARF, K. Embryologie der Angiospermen. Handb. der Pflanzenanat., Abt. II, Teil 2, Berlin, Borntraeger, 1929.
2. JOHANSEN, D. A. Plant Embryology. Waltham, Mass., Chronica Botanica Co. (To appear in 1946).
3. SOUÈGES R. Les lois du développement. Actualités Sci. et Industr., No. 521. Paris, Hermann et Cie., 1937.

P. W. RICHARDS: **The Biological Flora of the British Islands:** — The traditional flora, of which works such as HOOKER'S "Student's Flora of the British Islands" (3rd ed., 1884), COSTE'S "Flore de France" (1901-6) and BRITTON and BROWN'S "Flora of the northern United States" (1913) are excellent examples, has a long history. Mainly it is a development from the classical, mediaeval and Renaissance herbal, which served primarily as a manual for physicians and pharmacists collecting their own drug plants. The information given by the herbals is strictly in accordance with their purpose. First, there is a description and often an illustration of each species, intended to help in its recognition, next comes a more or less extensive account of the uses of the plant, and finally there may or may not be some indication of where it may be found. As time went on interest in plants became less narrowly utilitarian and the herbal which treated mainly of plants with real or supposed medical virtues developed into the complete catalogue of the plants of some defined area—the modern flora.

Though our floras have long left their medical origins behind, their basis is still the same kinds of information as were provided by the Renaissance herbals. The description for purposes of recognition has of course been quite transformed and the uses of the species generally occupy a less prominent place or are omitted altogether. The notes on where the plant may be found have grown into a summary of distribution with a statement, generally far too brief, on the nature of the habitat. The better floras, it is true, often give

data which had no place in the ancestral herbal, such as flowering and fruiting periods and details of floral biology. In the most elaborate modern floras, for instance HEGI's monumental "Illustrierte Flora von Mitteleuropa" (1906-31), the amount of this "biological" or not strictly taxonomic information becomes very considerable, though of course the amount of space which can be allotted to such data must depend among other things on the number of species to be dealt with.

The information which the present-day botanist would wish to find in a flora covers a far greater range than anything expected of the nineteenth century floras. He should look to the flora to provide him with not only the traditional morphological description and summary of distribution, but also with "biological" information of the most varied character, including cytological and genetical data, an adequate summary of the ecology of each species, including its phenology and relations to other organisms (especially animals and parasitic fungi), and an account of its post-Tertiary geological history, when known. Such a bulk of information is clearly more than can be compressed between the covers of a single book, even if, unlike many of the traditional floras, it is the work of a team and not of one man. What is now required is not one flora, but two; first the purely taxonomic flora giving in addition to the traditional types of information, data on variation, genetics and cytology, secondly a flora of a very different kind, a biological flora. The biological flora should consist of accounts of ecology—in the widest sense of the word—of all the species, genera and families in the area under consideration.

The compiling of a biological flora is bound to be a heavy task and is certainly far beyond the powers of one man, even for a country as small and poor in species as the British Isles. The materials are scattered through a voluminous and often inaccessible literature and must be supplemented by research much of which is necessarily tedious and time-consuming. The task, however, is one which will be well rewarded. Anyone with a close acquaintance with a group of species soon comes to realise that species are generally as well characterised ecologically as they are morphologically. Modern taxonomy must embrace not only the morphological and genetical characters of its units, but also their ecological and other "biological" characters. When a biological flora has been completed for a large group of species, or a whole genus, we can hope for much new light on the working of small-scale evolution, which we now know is due to the interaction of genetical systems with a constantly changing environment.

The only published work which approaches the ideal of the biological flora as here understood is the "Lebensgeschichte der Blütenpflanzen Mitteleuropas" begun in 1908 under the editorship of O. KIRCHNER, E. LOEW and C. SCHROETER. The information in this valuable work is overweighted on the morphological side and falls far short of modern requirements in the ecological and "biological" direction: even so, the publication has made little progress (last part issued 1936) and seems destined never to be completed.

A remark in the preface to the first edition of the "Student's Flora of the British Islands" shows that J. D. HOOKER already had the idea of a biological flora in mind in 1870. The first definite step towards a British biological flora was taken in 1928 when a committee of the British Ecological Society adopted a plan put forward by its convener, Professor E. J. SALISBURY, who was also appointed editor of the proposed flora. A questionnaire was circulated to members of the Ecological Society and others (J. Ecol. 16: 161, 1928 and J. Bot. Lond. 66: 48-50, 1928), asking for information about species growing in their districts. At the same time, a specimen account of *Scilla nutans* was published (J. Bot. Lond. 66: 50, 1928). This venture, promising as it appeared to be, made little progress, partly because it was difficult to obtain enough co-operation by means of the questionnaire, partly because the work of editing was more than could be accomplished by one man, even if he could give his whole time to it.

At a meeting of the British Ecological Society at Oxford in December 1940, the question of the biological flora was revived. It was pointed out during the discussion that such a flora was a pressing need for both pure and applied botany; sometimes important war work was hampered for the lack of the kind of information which might be obtained from such a flora. It was felt that during the war circumstances made long-term ecological investigations difficult or impossible, but

they might not be so unfavourable for a task which would consist largely of collecting together data already in existence. In the ordinary field experience of members of the Society, it was thought, much information about the biology and ecology of British plants must have accumulated, and even if only this existing information were brought together, it would make a very valuable body of reference.

Accordingly the Council of the British Ecological Society decided to embark once more on the preparation and publication of the flora. The scheme adopted differs in two important respects from that proposed in 1928. First, the writing of the flora is not to be the work of one man, but co-operative, different authors making themselves responsible for writing accounts of different species or groups of species, secondly the accounts of each species or small group of species are to be self-contained and not published in any regular order, but appear as the necessary information becomes available. The accounts are published first of all in the *Journal of Ecology*, afterwards they are re-issued and sold separately. The Council of the British Ecological Society is primarily responsible for the new flora, but it is edited by an informal committee consisting of Professor W. H. PEARSALL, editor of the *Journal of Ecology* (Sheffield), Dr. A. R. CLAPHAM (Oxford) and Dr. P. W. RICHARDS (Cambridge).

It is hoped that eventually the Biological Flora will become a complete account of the biology of all British flowering plants, conifers and pteridophytes, including naturalized aliens. As a guide to contributors, the following schedule has been drawn up:

I. (*a*) General distribution and abundance of the species in the district or districts described.
(*b*) Altitudinal limits.
(*c*) Other topographical limitations, e.g. restriction to north- or south-facing slopes, to open or shaded habitats, etc.

II. (1) Brief general description of the habitat or habitats.
(2) Description of the substratum.
Where a species occupies a great variety of habitats it may be impossible to give precise information under the following headings, but some indication of ranges and of the characteristics of the most frequent habitats will be valuable.
(*a*) Parent material.
(*b*) Appearance of the soil profile.
(*c*) Height and seasonal variation of the water table.
(*d*) Abundance of worms and other burrowing animals.
(*e*) Rate of incorporation and decay of humus.
(*f*) Appearance and texture of raw humus or peat, if present.
(*g*) *p*H at different depths (state how determined). The depths should be selected in relation to the layers of the soil profile and the rooting depth of the characteristic plants.
(*h*) Humus content or 'loss on ignition.'
(*i*) $CaCO_3$ content.
(*j*) Other chemical analyses (potassium, phosphate, total nitrogen, nitrate nitrogen, etc.).
(*k*) Mechanical analyses.
(3) Other features of the habitat, e.g.:
(*a*) Light intensity and its seasonal variation in relation to the life history of the species in question.
(*b*) Humidity of the air.
(*c*) Exposure to wind.

III. Communities in which the species occurs, with its frequency in each and with lists of closely associated species.
Complete lists with frequency symbols will be welcome, but lists only of the chief associated species and especially of the dominants will be adequate. It is important that any one list should refer only to one kind of habitat and to restricted areas, of about 1 sq. m., including the species in question. Lists should include characteristic species of other groups than Flowering Plants, if possible.

IV. Response of the species to biotic factors such as felling, burning, coppicing, mowing, peat-cutting, grazing, rabbit-nibbling, trampling, manuring, ploughing, etc.

V. (*a*) Gregariousness (solitary plants, large patches, small patches).
(*b*) Performance of the plant in its various habitats, e.g. average height; whether flowering freely, poorly or not at all.
(*c*) Sensitiveness to frost, drought and other exceptional weather conditions.

VI. (*a*) Morphology of underground parts.
(*b*) Depth, direction of growth and length of underground stem and functional roots.
(*c*) Presence or absence of mycorrhiza.
(*d*) Mode of perennation and general description of winter conditions.
(*e*) Mode and rate of vegetative reproduction and spread.
(*f*) Longevity of the individual plant.
(*g*) Age of plant at first flowering.
(*h*) Does the plant set seed (or produce seedlings) every year or at what intervals?
(*i*) Are any ecotypes known or suspected?
(*j*) Chromosome number, with authority.

VII. (*a*) Times of maximum growth of roots and other underground organs.
(*b*) Time of appearance of new leafy shoots.

(c) Time of flowering.
(d) Time of maturation and shedding of seeds.
(e) Time and place of germination of seeds.

VIII. (a) Mode of pollination of flowers.
(b) Insect visitors to flowers and their behaviour.
(c) Are cleistogamic flowers produced and, if so, when?
(d) Is reproduction amphi- or apomictic?
(e) Does vivipary occur?
(f) Does the species hybridize? By what criteria are the hybrids recognized as such? To what extent do the hybrids show a diminished fertility as compared with the parents? Do they show any differences in ecological behaviour?
(g) Average numbers of seeds per fruit and per plant.
(h) Mode of seed dispersal and special features, if any, *e.g.* seeds tend to stick together.
(i) Viability of seeds (state how determined).
(j) Special conditions affecting germination, *e.g.* sensitivity to light, necessity for preliminary freezing, etc.
(k) Short description and sketch of young seedlings.
(l) Relative importance of reproduction by seed and by vegetative means.

IX. (a) Insects feeding on the plant and the part or parts eaten by them.
(b) Plant parasites.
(c) Serious diseases. Describe the symptoms and give the names of the causal organisms, if any. Assess as far as possible the importance of the damage done by the diseases. Does the incidence of the disease vary with habitat and season?

X. History of the species as a member of the British flora, with notes on fossil records, dates of introduction of denizens and aliens, etc.

*Note on References to Insects* (O. W. Richards):—The lists of insects will in general be restricted to those closely associated with a single genus or species of plant, but may include some which feed on two or more allied genera of plants, or on a few genera living in the same habitat. Insects for which the records do not state the individual species of plants will be listed only in the accounts of genera.

Sometimes insects with polyphagous feeding habits may actually be more common on a plant than the restricted feeders, but the list of general feeders would be extremely long and very difficult to make complete. Where a general feeder is actually known to be a serious check to a plant, the record will be included.

Only British insects will be listed, but they will include some whose feeding habits may have been observed only on the Continent. Records will be given of the British distribution, in a very condensed form, where there is reason to think the information reliable. Absence of records often means that an insect has not been collected rather than that it is not present. The very imperfect state of the records of insect feeding habits and distribution must be stressed.

Lists will be given of the larger works from which records have been taken, and of the experts who have been consulted.

The range of information covered by the schedule is certainly rather formidable and it is realised that it cannot yet be provided for even a single British plant. Believing that "le mieux est l'ennemi du bien," the informal committee intends to publish accounts even when the information is incomplete in many particulars — any other policy would merely postpone publication indefinitely. The accounts will thus be summaries of information at present available rather than monographs in miniature. From time to time "Addenda and Corrigenda" will be issued and perhaps eventually—though this is looking far ahead—revised editions of earlier accounts.

Contributors to the Biological Flora are encouraged to ask for assistance in collecting data from both members and non-members of the Ecological Society. A group of highly qualified taxonomists have agreed to advise contributors on nomenclature and other taxonomic questions. Dr. O. W. Richards, of the Entomological Department, Imperial College, London, is assisting in zoological matters and Dr. Alex Smith of Harpenden is advising on references to Fungi.

The Biological Flora has already received a warm welcome and offers of collaboration have been many. Up to date (March, 1944) the following eleven accounts have been published: *Juncus, Juncus inflexus, J. effusus, J. conglomeratus* and *J. subnodulosus,* all by P. W. Richards and A. R. Clapham (J. Ecol. 29:362-91, 1941), *Cladium mariscus* by V. M. Conway (J. Ecol. 30: 211-16, 1942), *Zostera, Z. marina* and *Z. hornemanniana* by T. G. Tutin (J. Ecol. 30: 217-26, 1942), *Aster tripolium* by A. R. Clapham, W. H. Pearsall and P. W. Richards (mainly from data provided by V. J. Chapman) (J. Ecol. 30: 385-95, 1942), *Juncus macer* and *J. filiformis* by P. W. Richards (J. Ecol. 31:51-65, 1943), *Rhamnus cathartica* and *Frangula alnus* (*Rhamnus frangula*) by H. Godwin (J. Ecol. 31:66-92, 1943). Several more accounts will be published shortly; many others are in active preparation. Since it has been possible to make a good start under the difficult conditions of the war, we may well hope that the future of the Flora is assured and that after the war it will make a solid and increas-

ingly valuable contribution to knowledge of the British flora.

It is hoped that American readers of CHRONICA may be willing to help by contributing data on the distribution and ecology of British species found in America. Those willing to help in this way are invited to write to the writer of this article.

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A. C. ATWOOD: **Scientific Publications and the Indexer:** — When we were compiling the weekly list of Plant Science Literature and incorporating the material in the Botanical Catalogue of the U. S. Dept. of Agriculture Library, the staff was often moved to protest the methods or lack of methods in the make-up of scientific publications. What should be a moderately simple task is complicated by vagaries in forms used by authors and by the publications themselves, and much time is spent in trying to make clear and dependable entries. By calling attention to these difficulties we hope that consideration for the indexer and bibliographer may bring about a change in some of these practices.

*Author's names.* — Of course we would like to have the full name of the author given, but being a modest folk we do not expect too much and will be thankful if the first name is given in every case. It is not mere curiosity that makes the indexer wish to know the full names of authors, but the desire to have the records in the Catalogue correct and to give credit where credit is due. It is surprising how often writers on botanical subjects have not only the same surname but the same initials, and not always in the genus Smith. Take the case of A. S. FOSTER of Washington (names unknown) whose titles were credited to ADRIANCE S. FOSTER until a comparison of dates of publication and subjects indicated that two men were involved. Then there are the two THOMASES of California, HAROLD E. and HARVEY E., not to mention the German KARL MÜLLERS. These are only a few among the many instances, some of which are not so easy to resolve.

The addition of the author's position or affiliations after his name or at the end of the article, as is the practice in Phytopathology and a number of other American publications, is great help. We often have to track an author step by step, from one institution to another, from subject to subject, to assure ourselves of his identity.

American journals are somewhat better in this respect than foreign journals, English, French and Dutch particularly. As for the names of East Indians we are quite at a loss, as the manner of writing names seems to differ from one time to another (one author's name appeared in four different ways), and we have no authority on which to rely. Spanish and Portuguese names also add their problems, especially now that we are receiving more publications from the South American countries. The United States is, perhaps, better supplied with publications giving biographical data in regard to men and women in the field of science than most other countries. They are sometimes even included in Who's Who in America, while they are more rarely found in the English Who's Who; which may or may not indicate something as to the difference in our democracies.

Another trial is the transposition of joint and main author (junior and senior author) in continued articles or series. We appreciate that this is done to give proper credit to each but it causes considerable confusion and a necessity for extra references, and under the subject the entries are apt to be widely separated when one entry is under the main author whose name begins with B and the second, under the former joint author whose name begins with R.

*Titles.* — Titles are often vague and call for notes to indicate subject matter. A choice example is "An Australian sea rover" which suggests a sailor rather than *Asparagopsis armata*. In geographical botany such titles as "New localities," "A scanty flora," or "In quest of rare ones," can only convey something to the reader who has the periodical in hand or who is familiar with its character. Localities, if they cannot be given in the titles, should be given early in the article, preferably in the first paragraph, and so definitely that they can be located in any atlas; when the locality is too small to appear in an atlas it should be given with reference to some place that can be so found.

In titles having to do with a particular genus or species, what objection is there to giving the name of the genus or species in the title rather than to say "A new form genus of *Moniliaceae*," "A new species of *Tetraëdron* from Minnesota," or "Additional observations on positive and negative chemotaxis. Experiments

with a myxomycete"? When local or popular names are used the addition of the scientific name in the title would be an advantage, as in the title, "The Maya breadfruit in southern Florida." In some more popular articles the scientific name is not given even in the text, which we consider a reprehensible practice. In titles dealing with plant pathology such words as blight, rot, mildew, et cetera do not convey much unless the scientific name of the causal organism is given, or, if there is none, unless that fact is stated. "Iris rot" may mean something to the author and possibly to iris growers; but in our Catalogue such titles have to go into a limbo under "Rot" under *Iris. Diseases* being an indefinite heading that may mean anything, as we already have Bacterial soft rot and Rhizome rot (*Botrytis*).

When we turn to the many phases of plant biology with the innumerable technical contributions which they inspire, the titles often convey nothing to the lay mind as to the subject matter, and we sometimes doubt whether they do to the scientific mind; we think there is room for improvement though we realize that in many instances informative titles would run to too great length. In such cases the indexer is grateful for the growing custom of giving summaries at the end of the article (or abstracts at the beginning), which indicate the problem and the conclusions of the author. All the articles indexed cannot be read, not even those in English, and even if they could, one would prefer to quote the author rather than to supply conclusions of one's own. We hope the habit of giving summaries will become increasingly prevalent in all types of scientific publications.

*Dates of issue.* — It is amazing to find that publications dealing with scientific subjects are so careless about dates. Sometimes no dates are given, or they are hidden away in unexpected places, on the back cover, as footnote at the end or beginning of the article, or a year date only is given which may or may not be the actual year of issue. For example the Proceedings of the Iowa Academy for years (from v. 23 (1916) to v. 45 (1938) to be exact), gave no date save that of the year of meeting of the Academy, but as the volume never came to hand until the following year or later, we were constrained to take the date of receipt as the date of publication. The several Royal societies of the Australian Commonwealth may be suggested as models in this respect as the exact date of issue always appears on the title-pages and covers of each number.

A number of monthly journals like *Rhodora, Bulletin of the Torrey Botanical Club, American Journal of Botany,* and others, give the exact date on the number following, but this is too late for current indexing and in a Catalogue of the size of ours, to take out the cards to add the date after they have been filed, means so much extra work that it is impracticable. We have to content ourselves with giving the month date as it appears on the number in hand (adding the date of receipt when there is considerable discrepancy) and trust that the user will find out the exact date for himself. That it is not an impossibility to put the exact date on the number when it is published is evidenced by other publications such as *Botanical Gazette* which gives the exact date on the verso of the front cover of the number, and *Madroño* which gives the date at the foot of the first page of the number. We could wish that this practice of giving the publication date on the following number had not taken so strong a hold on many American journals.

*Continued articles and series.* — But the greatest trial to the indexer and that which perhaps wastes the most time is the continued article or the papers published in series. Not that we object to them *per se,* but because of the erratic way in which they appear. Too often the author gives no hint of what the previous number of his series was nor where it appeared. We have always a number of entries waiting for wanting parts, often we have to add a note to the effect that No. I has not been located or that No. II may be any one of the author's several contributions on the same subject. For an example of a more simple form of continuation take W. H. CAMP's Studies on the *Ericales.* We have records of I, III-IV appearing in v. 62, 65 and 66 of the Bulletin of the Torrey Botanical Club, but have not been able to locate No. II. In no case does the author indicate where his earlier numbers appeared though they were published several years apart. More recently L. H. LEONIAN published No. IV of his Studies on the nutrition of fungi (Amer. Journ. Bot. v. 27, No. 1, Jan. 1940). In his Literature cited the author refers to I (Phytopath. 28: 531) but not to II or III, nor is there any other reference to these earlier numbers.

These two examples involve only one author but where there are several authors and where changes in title occur the difficulties are increased. R. M. WHELDEN, C. F. BUCHWALD, F. S. COOPER and C. P. HASKINS published in the *Journal of General Physiology* (23: 391, 1940), "Electron bombardment of biological materials. II. The rate of death of fungus spores in vacuum with cathode ray beams &c." What No. I is we are not told, though WHELDEN's Changes observed in cultures of *Aspergillus niger* bombarded as spores with low voltage rays (Mycologia 30:265) and BUCHWALD and WHELDEN's Stimulation of growth in *Aspergillus niger* under exposures to low velocity cathode rays (Amer. Journ. Bot. 26: 778) are both cited in the authors' Bibliography and either might seem to meet the requirements.

A much longer series involving many joint authors and changes in main authors is E. L. TATUM and others' Growth factors for bacteria. This series begins with No. III, I and II having been published under separate titles and not numbered as belonging to a series. It is generally published in the *Journal of Bacteriology,* some numbers, however, have appeared in the *Biochemical Journal* and *Journal of Biological Chemistry.* No information is given as to earlier numbers, which has to be gleaned from abstract journals.

A complicated series was the "Studies in the genus *Mentha,*" of which No. 5-9 (by R. E. KREMERS or G. C. JENSEN and KREMERS), No. 11 (by H. A. BRAUN), No. 14 and 16 (by G. M. GORDON) only have been located. These appeared variously in the *Journal of the American Pharmaceutical Association, American Journal of Pharmacy,* and *Botanical Gazette,* from 1925-28.

There seems to be no limit to the ingenuity of those who make up series. In some cases we have a series with a subtitle No. I, when II appears we find the subtitle (of course different from I) promoted to first place while the series title is in small type following it, or even given as a footnote. Sometimes we have series within a series as in "Contributions to the flora of tropical America" which has been running in the *Bulletin of Miscellaneous Information, Royal botanic gardens, Kew,* for the last nine years and which has now reached No. XLII. With No. XXVII, Mr. A. A. BULLOCK begins a series on Mexican plants collected by Mr. G. B. HINTON, with No. XXXI it becomes Plantae mexicanae III and with No. XXXII, Plantae hintonianae IV. The "Kew Bulletin" has the excellent habit of referring to the last page of the preceding article and in this case states that the two earlier articles (preceding III) have differing titles. Of course when only the last page is given you must always look up the publication and cannot trace the articles through entries in the Catalogue, unless long experience in indexing this particular publication has taught you to make title references. If an author knows he is publishing the last part of his article we wish he would say so. We have no good short word like the French "fin" or the German "Schluss" for the purpose, unless we use the Anglo-Saxon word "end." Rhodora uses "conclusion;" it is somewhat long, but could be abbreviated to "concl." We urge the adoption of some such indication.

*Abstracts.* — We believe it was Dr. NEIL E. STEVENS who once said that abstracts were immoral because by an abstract an author often staked a claim which he never was able to take up. Without going so far we may say they are a necessary evil which might in some ways be mitigated. It happens more often than not, that the final article has an entirely different title from the abstract; not only that, but the subject matter of the abstract often constitutes but a small part of the article in finished form and the author of the abstract becomes a joint author. An extreme example of this was an abstract published in *Phytopathology* (13: 349, 1924) entitled "Metabolism in *Botrytis*" by A. HUNTER and G. H. BERKELEY, the full paper being BERKELEY's Studies in *Botrytis* (Trans. Roy. Canad. Inst. 15: 83-127, 1924) in which the first author's name appears only in the acknowledgments. We often wonder why it is necessary to publish an abstract when the full paper is appearing almost simultaneously, sometimes in the same or the following number of the same journal. It would seem sufficient to give the title only, with indication of where it is to appear in full. As much time is consumed in trying to locate the complete article, a footnote reference in the latter to the abstract would be of great help.

These are a few examples of the practices which try the soul of the indexer and which could easily be changed to the good of all concerned.

A paper which includes some of these same points but considered from the stand-

point of the journal rather than that of the indexer is Dr. M. C. MERRILL's Characteristics of a good journal article (Journ. Amer. Soc. Agron. 19: 17-26, 1927). Though published more than ten years ago it is still pertinent and judging from our experience has not been taken to heart as it should be.

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ANNA E. JENKINS: **Saint-Hilaire's Records of Damage from Wheat Rust in Brazil***: — AUGUSTE DE SAINT-HILAIRE'S references to wheat rust in Brazil are alluded to by PUTTEMANS (2, p. 32) and by GRILLO (1, p. 111) in their contributions to the "Primiera Reunião de Phytopathologistas do Brasil" held in Rio de Janeiro in 1936.

PUTTEMANS stated that "Cereal rust (*ferrugem dos cereaes*) and more especially wheat rust, which has caused so much damage to the economic culture of wheat in Brazil, seems to have existed among us for more than a century and was mentioned by SAINT-HILAIRE in connection with his trip through the interior" (3, p. 92). PUTTEMANS added that before 1905 wheat rust was attributed to *Puccinia graminis* or black rust, and that in that year he explained that it should be identified with *Puccinia glumarum* var *tritici*. He mentioned subsequent discoveries of *Puccinia graminis* in Brazil by RANGEL, himself, and GASSNER.

PUTTEMANS does not give exact citations to SAINT-HILAIRE'S *Voyages dans l'intérieur du Brésil* (4); in this work, however, I have found four passages mentioning wheat rust, three in the text of the travels in Minas Geraes in 1817, and one in that describing the journey to São Paulo in 1820.

Damage from wheat rust in Rio Grande do Sul mentioned in SAINT-HILAIRE'S diary for February 14, 1821, was given by GRILLO as the first record of a plant disease in Brazil. The diary of Rio Grande do Sul (5) furnishes four additional references to wheat rust, one in 1820, and three following that of February 14, 1821. I found these references in Dr. PENA'S translation of this work (6). Subsequently, he sent photographs of pertinent pages of the original French text (5).

SAINT-HILAIRE'S observations of wheat rust in Brazil, constituting a valuable contribution to early phytopathological history, are here assembled for convenience of reference.

*Minas Geraes.* — The first reference to be cited, in Chapter 16, of Volume 1, Part 1, of the "Voyages," deals with the excursions in Minas Geraes.* Leaving Villa do Principe for Passanha on April 4, 1817, SAINT-HILAIRE received hospitality the first night at the "Fazenda de Guanhaens." The diary mentions the good quality of the soil of this *fazenda*, and enumerates the various cultures, including wheat. The method of growing and harvesting this crop is then described. Wheat rust is referred to in the early part of the account, which therefore is here quoted:

"N'ayant point encore parlé de la culture de cette dernière plante, je vais en dire quelques mots. Comme sans doute elle s'accommoderait mal de l'excessive chaleur et des pluies si abondantes des mois de décembre, janvier, et février, on la sème en avril, pour faire la récolte en septembre et en octobre. Il est bien clair, d'après cela, que tous les terrains ne sauraient lui convenir, et que, croissant pendant la saison de la sécheresse, elle ne réussirait pas dans les pays découverts et naturellement secs. Ce doivent donc être les bonnes terres des cantons un peu élevés, et où de sombres forêts vierges entretiennent la fraicheur, qui lui sont le plus favorables. En général, la culture du froment est loin d'être commune dans la province des Mines, et les propriétaires dont les terrains pourraient être propices à cette culture, sont dégoûtés de s'y livrer, parce que trop souvent la rouille (*ferrugem*) attaque les moissons. Quoi qu'il en soit, le pays voisin de Passanha est un de ceux qui paraissent le mieux convenir au froment. . . ." (4, Vol. 1, Pt. 1, p. 390-391).

SAINT-HILAIRE again refers to wheat rust in the last chapter (Chapter 18) of Volume 1, Part 1, of his "Voyages." Thus in the account of agriculture in the vicinity of the village of Rio Vermelho, Minas Geraes, he writes (p. 448):

". . . La terre est cependant si fertile, qu'on a vu, m'a-t-on dit, un seul grain de blé donner jusqu'à soixante épis. Ainsi qu'aux environs de Sabará, on se sert ici de baguettes pour battre le froment; mais comme par cette méthode on perd beaucoup de grains, je tâchai de faire connaitre l'usage de notre fléau. Je crus devoir aussi indiquer l'opération du chaulage, non-seulement aux propriétaires de ce pays, mais encore à ceux de la route de Passanha, qui tous se plaignaient de la rouille (*ferrugem*)."

SAINT-HILAIRE'S third direct mention of wheat rust in Minas Geraes in 1817 is found in his account of the village of Piedade and its productions. The following is quoted:

"Le village de Piedade, qui peut avoir une soixantaine d'années (en 1817), manqua d'abord

* *Symbolae Phytohistoricae, No. 7.*

* A map showing SAINT-HILAIRE'S itinerary in Brazil accompanies his "Esquisse de mes Voyages au Brésil et Paraguay . . ." being reprinted in CHRON. BOT. 10 (1946).

d'eau, et alors sa population était très-peu considérable . . . .

"Il n'y a point de lavages dans les environs de Piedade. Les maisons de ce village appartiennent à des cultivateurs qui ne les habitent que le dimanche, et qui trouvent un débit facile de leurs denrées à Villa do Fanado. Le froment qui se consomme dans cette ville est en grande partie vendu par les cultivateurs des environs de Piedade; mais, comme tant d'autres agriculteurs brésiliens, ils se plaignent beaucoup de la rouille (*ferrugem*)."* (4, Vol. 1, Pt. 2, p. 271).

The fourth and last reference to wheat rust in SAINT-HILAIRE's "Voyages" to be cited here relates to his trip in Campos Geraes, São Paulo, which he visited in 1820. The passage containing mention of damage caused by wheat rust follows:

". . . Le froment cultivé dans ce pays est barbu et produit un grain fort petit; je ne me rappelle pas, au reste, que jusqu'alors j'eusse vu aucune autre espèce de blé dans les diverses parties du Brésil que j'avois parcourues. Soit dans les *campos*, soit dans les terrains qui ont remplacé des bois, ce blé rapporte environ 16 pour 1†; mais comme à Minas, les cultivateurs se plaignent beaucoup de la rouille. Le pain que l'on fait dans les Campos Geraes est fort blanc et très-savoureux. D'après ce que je viens de dire de la petitesse des grains du froment cultivé au Brésil il me paraît évident que cette céréale a diminué de grosseur dans ce pays, comme elle avoit déjà fait au Paraguay du temps d'AZARA‡; par conséquent, il serait extrêmement essentiel que l'on tirât d'Europe de nouvelles semences, et, si l'on ne prend pas ce parti, la dégenération ne s'arrêtera probablement pas au point où elle est aujourd'hui."§ (4, Vol. 4, Pt. 2, p. 24-25).

* "J'ai de la peine à croire que le blé, transporté du Portugal en Amérique, n'ait pas éprouvé quelques modifications dans ses caractères. Il serait intéressant d'observer quelles ont pu être ces modifications sous les diverses latitudes et dans les différens sols, de chercher quels remèdes on pourrait apporter à l'altération des qualités, si tant est qu'elles se soient altérées, et comment on reproduirait artificiellement les améliorations que le nature peut avoir offertes sans le secours de l'art. Jusqu'à présent, il faut l'avouer, les botanistes ont beaucoup trop négligé les plantes qui intéressent le plus notre espèce, pour courir après l'honneur futile de faire des divisions et des subdivisions nouvelles, et d'attacher les lettres initiales de leurs noms aux noms souvent barbares qu'ils donnaient aux plantes. L'heureuse direction que prend les esprits doit faire espérer que la science s'ennoblira par des observations de plus en plus philosophiques et par des applications utiles. Si mon inimitable ami, M. le Dr. DUNAL, peut terminer les recherches qu'il avoit commencées sur les variétés du blé et de la vigne, on verra combien de science et de philosophie on peut faire entrer dans ce genre de travail." (pp. 271-272).

† "Par les détails que j'ai donnés sur la manière dont on cultive le blé à Minas on verra qu'on y plante le grain au lieu de le semer comme dans les Campos Geraes; que, d'ailleurs, les semailles et la récolte se font à peu près aux mêmes époques dans les deux pays et que la semence rend autant dans l'un que dans l'autre. Voyez mon *Voyage dans les provinces de Rio de Janeiro et de Minas Geraes*. 1, 390)."

‡ "*Voyage dans l'Amérique méridionale*, 1, 139.)."

§ "M. le Dr. NEVES DE ANDRADA était parti de France pour Rio Grande do Sul il y a quelques années, avec d'excellente semence de froment de Beauce et de blé noir de Sologne que je lui avois procurée; je ne sais quel résultat il aura obtenu."

*Rio Grande do Sul.* — Excerpts from SAINT-HILAIRE's diary of his trip to Rio Grande do Sul, in which wheat rust is mentioned are given below:*

The first is from the diary of October 8, 1820:

"Sainte-Thérèse, 8 octobre. — J'ai été aujourd'hui me promener avec mon hôte jusqu'à un paturage (*patreiro*) que la nature elle-même a pris soin d'enclore de tous les côtés par de vastes marais et qui a 7 lieues de tour. Comme les titres de celui qui s'en disait le propriétaire n'ont pas paru suffisants au comte DE FIGUEIRA, il en a pris possession pour y mettre les chevaux et les boeufs que appartiennent au Roi.

"Depuis Rio-Grande jusqu'ici, j'entends tous les agriculteurs se plaindre de la rouille. . . ." (5, p. 145).

SAINT-HILAIRE's next two references to wheat rust in Brazil appear in his diary for February 14, 1821, referred to by GRILLO, and in that for February 16, 1821.

The excerpt from the diary for February 14 follows:

"Nous nous sommes arrêtés, pour faire reposer les boeufs, à une chacara qui dépend d'une estancia où nous devions passer la nuit. Nous y avons trouvé un grand hangar sous lequel nous avoins fait entrer la charrette à l'abri et une chaumière où était un vieil Indien avec ses enfants et sa femme. Comme le temps s'est mis à l'orage et que les effets sont parfaitement à l'abri, je n'ai pas voulu aller plus loin.

"Il y a, sous le hangar, un assez bon nombre de surons de blé recueilli ici. La rouille a fait le plus grand tort à la dernière récolte, mais les blés qui sont venus sur les terres de cette chacara n'en ont point été attaqués. Les sacs ou surons, dans lesquels les cultivateurs de cette capitainerie gardent leur blé, se font avec des cuirs entiers, cousus de lanières étroites de cuirs. Le mot indien *chacara* veut dire proprement un plantation. Peu à peu les Portugais et les Espagnols en ont étendu la signification et les maisons de campagne les plus agréables des environs de Rio-de-Janeiro ne portent actuellement d'autre nom que celui de chacara." (5, p. 332).

The excerpt from the diary of February 16 is of added interest because it mentions the introduction of a kind of wheat that proved to be resistant to the rust, while ordinary wheat was practically destroyed. The passage follows:

"Je n'ai pas été moins bien reçu aujourd'hui qu'hier. Quand je suis arrivé, on m'a fait prendre le maté; bientôt après, nous avons déjeuné avec des fruits et de la viande rôtie; enfin, sur les cinq heures, nous avons fait un fort bon diner où l'on a servi plusieurs plats de viande, des haricots, du riz et des citrouilles, des pêches, des melons, des figues et des melons

* These excerpts are from the original French text (5), from which photographs of pertinent pages were kindly contributed by Dr. PENA.

d'eau. Le vin n'a point été oublié, il y avait tout à la fois sur la table du pain, du biscuit ou de la farine de manhoc. Le riz avoit été cueilli dans le pays, aussi bien que le froment avec lequel avaient été faits le pain et le biscuit.

Mon hôte se plaint de la rouille, mais, il m'a dit qu'il avait semé l'anné (sic) [année] dernière une espèce de blé appelée *trigo-manco* nouvellement introduit dans le pays et que ce blé n'avait point été attaqué de la rouille, quoique le terrain qu'il couvrait touchât à un champ ou l'on avait semé du blé ordinaire qui fut presque entièrement détruit par cette maladie." (5, p. 335).

The next diary of SAINT-HILAIRE to be cited is entitled, "Estancia de Santos-Reis, 1° de Marco."* The pertinent text follows:

"Je devais partir hier, mais, comme j'avais encore quelques arrangements à prendre, j'ai été forcé de rester un jour de plus. Cette nuit, il a fait de l'orage, et, quoique le temps fût douteux, je me suis mis en route vers les dix heures. Je devais passer la rivière de *Camapuan* et aller coucher plus loin; mais j'avais à peine fait une lieue que le tonnerre a commencé à gronder et bientôt il est tombé beaucoup de pluie. Nous sommes venus nous réfugier à cette estancia que est un peu écartée du chemin, mais où du moins nous avons trouvé un abri. Le propriétaire, qui est l'administrateur de Saint-Nicolas, est absent; j'ai été reçu par un nègre qui a été fort honnête; j'ai encore trouvé ici une famille d'Indiens réfugiés. Ces infortunés se sont dispersés dans tout ce pays et ils y trouvent peu de moyens d'existence.

Le nègre de l'administrateur m'a dit que les terres de ce canton étaient très propres à la culture mais il dit, comme tant d'autres, que la rouille fait beaucoup de mal au blé . . ." (5, p. 353).

The second passage from the diary of 1821 in which wheat rust is mentioned also refers to two kinds of wheat less subject to the rust than the usual sort:

"Villa de Rio-Pardo, 3 mai. — Les cuirs et le froment sont les principales denrées qu'exportent les négociants de cette ville; et c'est de Rio de Janeiro directement qu'ils tirent presque toutes leurs marchandises.

On cultive beaucoup de froment dans les environs de cette ville, principalement sur les paroisses d'Encrusiada et de Taquari. Comme partout ailleurs, on se plaint beaucoup de la rouille, mais on a récemment introduit dans le pays deux sortes de blé qu'on appelle *Trigo-branco* et *Trigo-moro,* qui sont beaucoup moins sujettes à cette maladie que l'espèce ordinaire à laquelle on donne le nom de *Trigo-creolo,* parce qu'elle est le plus ancienne." (5, p. 463).

SAINT-HILAIRE was again to hear of extreme damage from wheat rust in Minas Geraes. Thus, upon revisiting that province before embarking for France (June 1822, *cf.* 8), he wrote in his diary for March 7, 1822:

On a cultivé avec succès le froment dans la Serra de Juruoca; mais ceux qui se livraient à cette culture y ont renoncé parce que la rouille qui avait longtemps respecté leurs plantations avait fini par y faire le plus grand tort."* (5, p. 644).

If, perchance, SAINT-HILAIRE gathered examples of the wheat rust that he found so widely distributed in Brazil, it is to be expected that these are still preserved in the "Muséum d'Histoire Naturelle" of Paris along with his other collections.

At the present time it is impossible to determine whether such specimens are in existence, but, if they are, perhaps the kind or kinds of wheat rust observed by SAINT-HILAIRE at this earliest period in Brazilian phytopathological history may yet be determined. Dr. H. B. HUMPHREY, of the Division of Cereal Crops and Diseases, U. S. Dept. of Agriculture, has suggested to me that the organism referred to was either *Puccinia graminis tritici* or *P. glumarum tritici,* both of which are capable of producing easily observable damage to the crop, whereas, the injury resulting from *Puccinia rubigo-vera tritici* generally is much less obvious though perhaps none the less real from the standpoint of depreciated yields.

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(4.) SAINT-HILAIRE A. DE: Voyages dans l'intérieur du Brésil (1816-1822). Paris, 1830-1851. *See* Vol. 1, Pt. 1, pp. 391 and 448; Pt. 2, p. 271 and Pt. 4, p. 24.

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* Quotation from the translation (7, p. 253). The translator states that this *estancia* is well known today as belonging to the family of the present President of Brazil, Dr. GETULIO VARGAS.

* This quotation is taken direct from SAINT-HILAIRE's "Rio Grande do Sul" of which a copy became available after this article was in proof. The reference was first found in TAUNAY (7, p. 110).

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I. C. VERDOORN: **On the Genus Aloe:** —*Preparation of herbarium material at Pretoria.* — Owing to the difficulty of making satisfactory herbarium specimens of these plants the genus *Aloe* has hitherto been very poorly represented in herbaria. Not only is the succulent nature of the plant a difficulty, and in many cases its bulk and spines, but the flowers have a tendency to drop during the process of drying and they lose their shape completely through the loss of the watery cell-contents. A method of preparing herbarium material of these plants has been evolved at the National Herbarium, Pretoria, which, although it may still be improved upon, has been quite satisfactory. The inflorescence is submerged as soon as possible in diluted formalin (4%) and left there for 24 hours. This kills the tissues quickly, preventing the dropping of the flowers, and gives them a certain degree of toughness. When the inflorescence is taken from the large porcelain drum containing the formalin it is left to drain for a few minutes and then cut so as to fit on to the standard herbarium sheet. If representative parts will not fit on to one sheet two or more sheets may be used for the one specimen. Very dense and thick racemes are cut through longitudinally. The leaves are treated separately; very thick ones and those that are spotted are not always put into formalin but may be sliced through, carefully leaving the upper surface with the horny and usually spiny margin intact. Both upper and lower surfaces are kept. In order to indicate the thickness and original shape of the leaf a cross section is cut (just above the base). This cross section is outlined in pencil or an impression of the section is made on paper to be preserved with the specimen. All the prepared parts of the plant are then put into a press where artificial heat from electric elements dries it within about 48 hours. Wherever possible these mounted specimens are supplemented in the herbarium by good photographs, such as a habitat photo, a close up of the whole plant and a life size photo of 5 of the flowers (from bud stage to the fertilized flower). The last mentioned is taken on glass to do away with the shadow. These, together with good collectors' notes, aim at giving as complete a picture as possible of the living plant.

*Building up the collection.* — Since the systematists in the herbarium have very little time or opportunity for collecting and studying the plants in the field, the policy has been adopted of assisting and encouraging amateur botanists as much as possible and in this way excellent specimens, photographs and notes are accumulated. In South Africa this has resulted in one of the amateurs, Mr. G. W. REYNOLDS of Johannesburg, taking up the study of the genus in this region and the National Herbarium is indebted to him for excellent specimens, photographs and notes of the South African species and his type specimens are all housed here. Regarding the rest of Africa this herbarium is fortunate in coöperating with an *Aloe* enthusiast in Rhodesia, Mr. H. BASIL CHRISTIAN, who on his farm Ewanrigg near Salisbury, is growing and studying tropical and sub-tropical species. In getting plants from those distant and more inaccessible regions the war has created certain facilities. For instance, South African plant lovers serving in the Abyssinian campaign sent in plants from Kenya and Abyssinia. Then, too, officials in the African Colonies such as Uganda, Kenya and Tanganyika, cut off from Europe, come to the Union for leave and, learning of the work on *Aloes*, send in plants on their return. By exchange and keeping in touch with Mr. CHRISTIAN it is hoped that a representative collection of species north of the Limpopo will also be found in this herbarium.

*The study of the genus.* — The genus *Aloe* is essentially African and it is presumed that it originated somewhere in the tropics, migrating northwards and southwards. As with most of the African flora the southern-most limits were the first to be studied, for, the opening of the Cape route to the East synchronised with an interest taken in botany in Europe and the establishment there of several famous gardens. Collectors for these gardens sent plants of *Aloe* species from the Cape. So it came about that the genus was described by LINNAEUS and several species were illustrated and described by such well known botanists or botanical artists as HAWORTH, SALM-DYCK, REDOUTÉ and JACQUIN. In 1908 the genus was very ably revised by A. BERGER in Das Pflanzenreich. His descriptions of the species and the classification of them are excellent

but much of his work was based on plants growing in the garden at "La Mortala," Italy, and there is some doubt about the exact origin of many of them. Of the few herbarium sheets quoted by BERGER some are so poor that it is with difficulty that one can recognize the species from them.

After BERGER, interest in the genus *Aloe* was revived by Dr. I. B. POLE EVANS, who not only described several new species, mostly from the Transvaal, but he introduced and stimulated the use of these plants in local rock gardens. The grounds of the Union Buildings and Government House at Pretoria, also many private gardens throughout the country, owe much of their elegant and colourful winter glory to Dr. POLE EVANS' efforts in this direction. He instituted the illustration of the species by photographing the plant and the life size flowers. It was Dr. POLE EVANS who founded the periodical "Flowering Plants of South Africa" where, up to date, no less than 92 coloured illustrations of *Aloe* species have appeared. Following Dr. POLE EVANS' stimulus we have among others the two workers mentioned earlier, Mr. G. W. REYNOLDS of Johannesburg, who has compiled a revision of the South African species and is preparing his work for the press, and Mr. H. BASIL CHRISTIAN, who, on his farm Ewanrigg near Salisbury in a magnificent rock garden, grows and studies the tropical and subtropical species. Mr. CHRISTIAN has described over a score of new species and there appear to be many still to come; also Mr. CHRISTIAN has a great task before him trying to identify the tropical species already described (mostly by BERGER). At this stage therefore it is impossible to find the right relationships of the tropical species and group them accordingly. It will be interesting to see what the result will be when the study which started on the outliers at the Cape finally reaches and clears up those at the heart and origin of the genus in Tropical Africa.

NATIONAL HERBARIUM,
PRETORIA, SOUTH AFRICA.

JACQUES ROUSSEAU : **L'Annedda, l'arbre employé par Jacques Cartier contre le scorbut***: — Pendant l'hiver de 1535-36, au cours du second voyage de JACQUES CARTIER en Nouvelle-France, l'équipage fut fortement atteint du scorbut. Voyant disparaître ses hommes, le commandant de l'expédition fit appel aux conseils des Indiens.

"Le cappitaine" (1), écrit CARTIER (2), "voyant ledict dom Agaya sain et déliberé, fut joieulx espérant par luy sçavoir, comme il s'estoit guery, affin de donner aide et secours à ses gens. Et lors qu'ilz furent arrivez près le fort, le cappitaine luy demanda comme il s'estoit guery de sa maladie. Lequel dom Agaya respondit, que avecq le juz des feulhes d'vn arbre et le marq, il s'estoit guery, et que c'estoit le singullier remedde pour maladie. Lors le cappitaine luy demanda s'il y en avoyt poinct là entour, et qu'il luy en monstrast, pour guerir son serviteur, qui avoyt prins ladicte maladie en la maison du seigneur Donnacona, ne luy voulant déclerer le numbre des compaignons, qui estoient malades. Lors ledict dom Agaya envoya deulx femmes avecq nostre cappitaine, pour en querir, lesquelz en apportèrent neuf ou dix rameaulx; et nous monstrèrent, qu'il failloyt piller l'escorce et les feulhes dudict boys, et meptre le tout boullyr en eaue; puys boyre de ladicte eaue, de deux jours l'vn; et meptre le marc sus les jambes enfflées et malades; et que de toutes maladies ledict arbre garissoit. Ilz appellent ledict arbre en leur langaige, *annedda.*

"Tost après, le cappitaine fict faire du breuvaige, pour faire boire es malades, desquelz n'y avoyt nul d'eulx qui voullust icelluy essaiger, sinon vng ou deulx, qui se mirent en adventure d'icelluy essayer. Tout incontinent qu'ilz en eurent beu, ilz eurent l'advantaige, qui se trouva estre ung vray et evident miracle; car de toutes les maladies de quoy ilz estoient entachez, après en ayoyr beu deux ou troys fois, recouvrèrent santé et guarizon, tellement que tel des compaignons, qui avoyt la verolle puis cinq ou six ans auparavant la maladie, a esté, par icelle médecine, curé nectement. Après ce avoyr veu, y a eu telle presse, que on se voulloit tuer sus ladicte médecine, à qui premier en auroyt; de sorte que vng arbre, aussi groz et aussi grand que je vidz jamais arbre, a esté employé en moings de huict jours, lequel a faict telle oppération, que si tous les

* *Symbolae Phytohistoricae, No. 8.*

(1.) JACQUES CARTIER.
(2.) Texte tiré de l'édition critique de BIGGAR, H.P.—*The voyages of Jacques Cartier.* Published from the originals with translations, notes and appendices. Publication of the public archives of Canada, No. 11, 330 pages, Ottawa, 1924. Tous les textes botaniques de CARTIER ayant quelque intérêt botanique sont reproduits dans l'étude de JACQUES ROUSSEAU sur la *Botanique canadienne à l'epoque de Jacques Cartier,* citée plus loin.

médecins de Louvain et Montpellier y eussent esté, avecques toutes les drogues d'Alexandrie, ilz n'en eussent pas tant faict en vng an que ledict arbre a faict en huict jours; car il nous a tellement prouffité, que tous ceulz qui en voullu vser, ont recouvert santé et garizon, la grace à Dieu."

Un autre texte de CARTIER, dans le récit du troisième voyage effectué en 1541-42, —connu uniquement par la traduction anglaise de HAKLUYT (3), — se rapporte également à l'annedda. Il se lit: "And there is one kind of tree above three fathoms about, which they in the Country call Hanneda, which hath the most excellent vertue of all the trees of the world, whereof I will make mention hereafter." Le reste du texte est perdu.

Il importait de citer au long ces extraits et pour le premier de s'en remettre à l'édition la plus critique des récits de CARTIER, — car c'est sur eux essentiellement que doit porter la discussion.

L'identité de l'*annedda* a fait l'objet de plusieurs études, citées pour la plupart dans les travaux de BIGGAR (2), PARISEAU (4) et ROUSSEAU (5). Depuis, le périodique américain *Science* (6) a publié sur le sujet des notes renfermant parfois les opinions les plus invraisemblables.

(3.) HAKLUYT. — *The third and last volume of the voyages, navigations, traffiques and discoveries of the english nation*, etc. . . . Londres, 1600. Pour le texte, voir BIGGAR, op. cit., ou ROUSSEAU, *La botanique canadienne à l'époque de Jacques Cartier* (pp. 12 et 20-21 du tiré à part), cité plus loin.

(4.) PARISEAU, LÉO. — *En marge du récit de la "Grosse maladie du capitaine Cartier."* Journal de l'Hôtel-Dieu, 3: 217-285 (juillet-août) Montréal, 1934. Aussi Bulletin de l'A.M.L. F.A.N., et tiré à part.

(5.) ROUSSEAU, JACQUES. — *La botanique canadienne à l'époque de Jacques Cartier.* Annales de l'ACFAS, 3: 151-236. 1937. Aussi tiré à part dans Contrib. lab. bot. Univ. Montréal, No. 28, 86 pp. 1937.

(6.) a. Revue de: *A history of five centuries of English diet*, by B. J. C. DRUMMOND and WILBRAHAM. Science, 91 (no. 2357): 217. March, 1940.

b. MACNAMARA, CHARLES. — *The identity of the tree "Annedda."* Science, 91 (no. 2376): 35. July, 1940.

c. DONNELLY, MAURICE. — *Vitamin C in evergreen-tree needles.* Science, 98 (no. 2536) 132. August, 1943.

d. SCHICK, BELA. — *A tea prepared from needles of pine trees against scurvy.* Science, 98 (no. 2541): 241-242. Sept. 10, 1943. (Notes ne contenant aucune mention de l'*annedda*.)

e. MACNAMARA, CHARLES. — *Vitamin C in evergreen tree needles.* Science, 98 (no. 2541): 242. Sept. 10, 1943.

f. DUNHAM, WALCOTT B. — *Vitamin C from evergreens.* Science, 98 (no. 2545) 325. Oct. 1943.

g. HARRINGTON, JOHN P. — *Vitamin C from evergreens.* Science, 98 (no. 2545): 329. Oct. 8, 1943.

h. VILLELA, GILBERTO G. — *Vitamin C in the needles of some Conifers.* Science, 99 (no. 2563) 125. Feb. 11, 1944.

Certain auteur ne va-t-il pas même jusqu'à rééditer une vieille interprétation surannée et assimiler l'*annedda* au *Sassafras*, absent du Québec?

Le problème pour être traité de façon satisfaisante, doit être envisagé sous quatre aspects: (1) morphologique, (2) linguistique, (3) phytogéographique et (4) historique.

1. Nous savons par le récit que l'*annedda* est un grand arbre; en outre, il conservait ses feuilles en plein hiver. C'est donc un conifère, mais assurément pas le *Larix*, qui perd ses feuilles à l'automne, ni des plantes arbustives telles que le *Taxus*, le *Juniperus communis* et le *J. horizontalis*. Les détails morphologiques tirées des textes de CARTIER ne font donc que circonscrire le choix.

2. La linguistique, tout au plus, confirme le point précédent et, si on lui accorde ici une attention trop sommaire, peut ajouter simplement à la confusion. Les Amérindiens rencontrés par CARTIER à Stadaconé, — aujourd'hui Québec, — étaient du groupe iroquois, ainsi qu'en témoignent les mots cités dans la relation du voyage. Le nom *annedda* et ses variantes s'appliquent actuellement dans les tribus iroquoises à divers conifères. C'est même parfois un nom générique pour tous les conifères, un peu comme *sapin*, *fir* et *pine* dans l'onomastique populaire française et anglaise. PARISEAU (4) et ROUSSEAU (5), — et les auteurs antérieurs cités par eux, — ont déjà résumé toute la discussion, qui demeure sans solution.

3. La phytogéographie circonscrit davantage le choix. Nous savions déjà que l'*annedda* est un conifère arborescent de la région de la ville de Québec. Le choix se limite donc aux espèces suivantes: *Abies balsamea, Picea mariana, Picea rubens, Picea glauca, Pinus Strobus, Pinus resinosa, Thuja occidentalis, Tsuga canadensis.*

4. Pour une identification plus complète, nous en sommes donc réduits à la preuve historique. Les essais des historiens ont été infructueux. Ces tentatives d'identification faites si longtemps après les voyages de CARTIER, — et sans l'aide d'une tradition sûre, — sont à rejeter. Une seule, tirée d'un récit du moine ANDRÉ THÉVET (7), mérite l'atten-

(7.) THÉVET, ANDRÉ. — *Singularitez de la France antarctique.* L'édition citée est celle de GAFFAREL, 1878. Les textes botaniques de THÉVET sont reproduits et commentés dans ROUSSEAU, *La botanique canadienne à l'époque de Jacques Cartier*, pp. 25 et 41-42 du tiré à part.

tion. THÉVET fit un voyage dans l'Amérique du Sud et publia au retour (1557-58) une étude sur les pays visités, renfermant des observations personnelles et des histoires de ouï-dire. Ayant fréquenté CARTIER et DONNACONA, — ce dernier ramené en France après le second voyage, — THÉVET, comme le découvreur du Canada, ajouta à ses récits des renseignements obtenus du chef indien (8). Quand l'équipage fut guéri du scorbut par une infusion d'*annedda*, DONNACONA était alors chef de Stadaconé et devait certainement bien connaître ce remède enseigné par les siens et comme il apprit à parler français, il n'y a sans doute pas eu de confusion. Voici le texte de THÉVET (7): "Aussi ne veux omettre cecy qui est singulier, que quand lesdits Sauvages sont malades de fievre ou persecutez d'autre maladie intérieure, ils prennent des fueilles d'un arbre qui est fort semblable aux cedres, qui se trouvent autour de la montagne de Tarare, qui est du Lyonnois: et en font du jus, lequel ils boivent. Et ne faut doubter que dans vingt quatre heures il n'y a si forte maladie, tant soit elle inveterée dedans le corps que ce breuvage ne guerisse; comme souventes fois les chrestiens ont experimenté, et en ont apporté de la plante par deça." En marge se trouve la note: "Bruvage souverain dont ils usent en leurs maladies." Il n'est pas question ici nommément du *scorbut* ni de l'*annedda*, mais il est permis de penser qu'il s'agit de l'un et de l'autre. Si cette interprétation, pour le moment la plus vraisemblable, est exacte et que l'information recueillie par THÉVET est correcte, l'arbre ne pourrait être que le *Thuja occidentalis*, car le nom *cèdre* en France s'appliquait surtout aux *Juniperus* à feuilles imbriquées et squamiformes comme celles du *Thuja*.

L'unique espoir de trouver une solution définitive réside dans la découverte de la relation complète du troisième voyage de CARTIER, dont on ne connait actuellement qu'un fragment traduit en anglais. On se souvient que dans le passage d'HAKLUYT (3), après avoir parlé de l'*annedda*, l'auteur ajoute: "whereof I will make mention hereafter." Or cette dernière partie du récit est disparue.

Quant à la vitamine C, — antiscorbutique, — il n'est pas impossible qu'elle soit présente dans la plupart de nos conifères. Il y a quelques années, le professeur E. W. MCHENRY (9), du School of Hygiene de l'université de Toronto, fit des analyses de l'écorce interne et des aiguilles du *Picea glauca*. Il a trouvé de 20 à 30 milligrammes de vitamine C par 100 grammes d'écorce et une teneur des plus variables dans les aiguilles.

JARDIN BOTANIQUE,
MONTRÉAL, CANADA.

(8.) Ces témoignages de ouï-dire inspirèrent une satire à RABELAIS. Voir à ce sujet: BARBEAU, MARIUS. *La merveilleuse aventure de Jacques Cartier*. 117 pp. (Editions Albert Lévesque) Montreal, 1934. Aussi du même auteur: *Cartier inspired Rabelais*, Canadian Geographical Journal, 9: 113-125. 1934.

(9.) Résultats inédits. Seront publiés avec les analyses semblables faites sur les plantes arctiques.

ROY W. NIXON: **The Need for a Monograph of the Date Varieties of the World:** — During the past 20 years the writer has been impressed by the need for a systematic study of date varieties as they occur in the Old World. Between 1890 and 1929, in order to test the possibilities of date culture in southwestern States, the U. S. Department of Agriculture made 1076 experimental importations of date offshoots from the more important date growing countries—Iraq, Algeria, Tunisia, Egypt, Morocco, Baluchistan, and Southeastern Arabia. Date growers themselves made several large commercial importations. A large assortment of varieties was collected with only a very few imported in such quantities as to leave little doubt as to their identity. In a number of instances the same variety was imported under several different names, and in a still larger number of instances two or more varieties were brought in under the same name. In a bulletin recently completed and to be published by the U. S. Department of Agriculture at a later date, 159 varieties are described in more or less detail. The identity of more than two-thirds of these varieties cannot be verified because of the lack of descriptive data from the Old World.

Only very meager information on date varieties is available in the literature. There are a number of lists of varietal names with occasional comments about the fruit. The few attempts that have been made to cover the varieties of a particular region have been confined mostly to the ripe fruit which loses so much of its characteristic shape and color in ripening that from it alone positive identification of a given variety is seldom possible. For the most part little or no attention has been given to the leaf characters which, unlike the fruit, are present

throughout the year and often afford a means of positive identification.

It is not surprising that there was confusion of varieties in our importations of offshoots. Apparently there are only a few varieties in any one date growing country that have been grown extensively enough to be widely recognized. Even among these there may be confusion in different parts of the same country. In the course of investigations in Iraq the writer found that the variety by the name of Khadrawy grown extensively on a commercial scale in the Basrah region was an entirely different date from the variety by the same name well known in the Baghdad area. The fruit of these two varieties is indeed so similar as to be hardly distinguishable, but the palms are quite different. There is still a third distinct variety by the same name in Tunisia. In all the principal date growing countries there are varieties by the name of "Hamraya," or variant transliterations, all stemming from the Arabic word meaning "red." Other examples could be given. Until all these varieties have been studied and adequately described it is impossible to avoid confusion.

A monograph of the date varieties of the world would make possible a comparison of the peculiar merits of the different varieties in different countries. From observations of the writer the selection of date varieties in the Old World is largely a matter of chance. While in the course of centuries this has resulted in a few very good varieties being cultivated on a fairly large scale, it does not, by any means, follow that all good varieties are selected and cultivated. In fact, sometimes the very excellence of a new variety causes it to be jealously guarded by its owner and thus prevents its extensive propagation. A few such instances came to the attention of the writer in Iraq. A systematic study of the date varieties of the world would undoubtedly bring to light many promising varieties now being overlooked. It would be helpful in all countries where dates are grown; it would stimulate interest in varieties among the Arabs themselves; it would aid in the development of date culture elsewhere. There are extensive areas in Russia, Australia, and South America where dates are not now grown, but where date culture has definite possibilities.

A few new varieties might be of great value in our own country. The commercial production of dates in the United States is largely concentrated on one variety, Deglet Noor, which represents about three-fourths of the commercial acreage. Yet this variety is grown almost exclusively in one small locality; it has been a failure elsewhere in southern California and Arizona although distinct possibilities for date culture have been demonstrated over much of this area. Other varieties already imported do better, but have drawbacks that make their future somewhat questionable. It should be borne in mind that our present production of dates is only about one fifth of the normal consumption in this country, and the normal consumption of about one-half pound per capita per year in the United States is so low in comparison with that of other countries as to suggest a considerable possible future increase in date acreage in the Southwest.

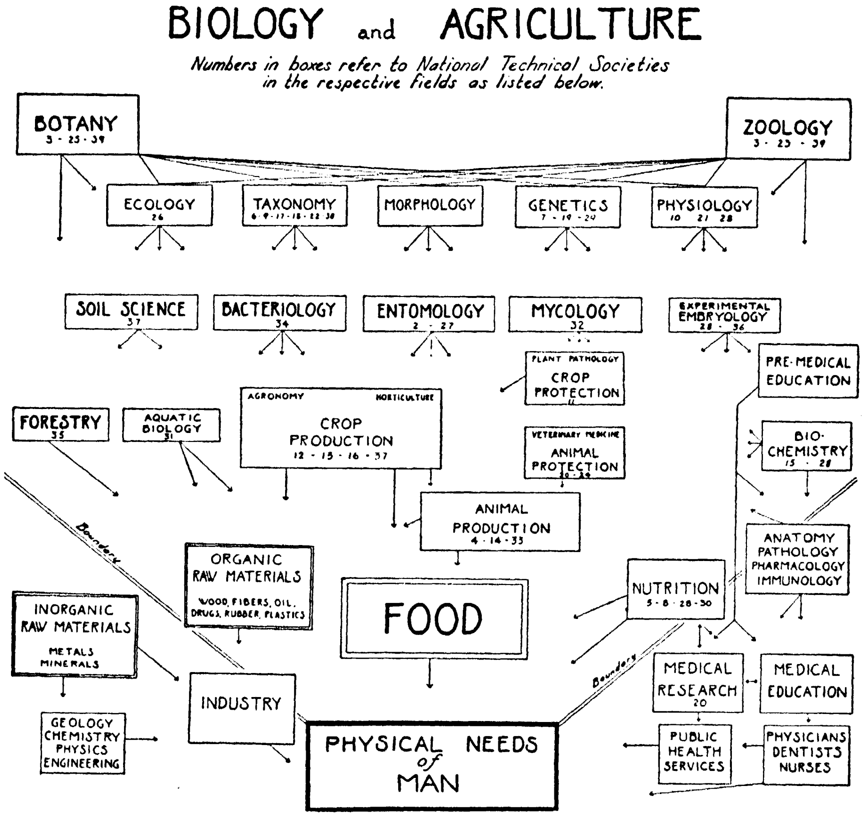
The possibilities of obtaining new and better varieties of dates by a carefully planned long-time breeding program have never yet been investigated. Such a breeding program should have as its background a systematic study of all existing varieties. A monograph of the date varieties of the world would be a definite contribution to the advancement of one of the world's oldest and most important horticultural crops.

U. S. Date Garden,
Indio, California, U.S.A.

# QUOTATIONS

● **The Organization of Biology and Agriculture** (Robert F. Griggs, Chairman, Div. of Biology and Agriculture, U. S. Research Council and Professor of Botany, George Washington University, Washington, D. C. *in* Science 96:545-551, 1942): — Over and over again as I endeavor to facilitate the contributions of biology and agriculture toward winning the war, I encounter the unorganized and incoherent condition of our group of sciences. I have come to believe that this lack of organization, and the lack of unified objectives that goes with it, is of itself partly responsible for the comparatively ineffective application of biology and agriculture to the needs of a total war.

To assist in clarifying our functions and our responsibilities, I have constructed an organization chart (*below*). In its conception the chart is entirely abstract. Its contact with the present situation comes through the numbered references in the appro-




Organization Chart. — National Technical Societies: 1. American Association of Anatomists. 2. American Association of Economic Entomologists. 3. American Biological Society. 4. American Dairy Science Association. 5. American Dietetic Association. 6. American Fern Society, Inc. 7. American Genetic Association. 8. American Institute of Nutrition. 9. American Ornithologists' Union. 10. American Physiological Society. 11. American Phytopathological Society. 12. American Society of Agricultural Sciences. 13. American Society of Agronomy. 14. American Society of Animal Production. 15. American Society of Biological Chemists, Inc. 16. American Society for Horticultural Science. 17. American Society of Ichthyologists and Herpetologists. 18. American Society of Mammalogists. 19. American Society of Naturalists. 20. American Society of Parasitologists. 21. American Society of Plant Physiologists. 22. American Society of Plant Taxonomists. 23. American Society of Zoologists. 24. American Veterinary Medical Association. 25. Botanical Society of America, Inc. 26. Ecological Society of America. 27. Entomological Society of America. 28. Federation of American Societies for Experimental Biology. 29. Genetics Society of America. 30. Institute of Food Technology. 31. Limnological Society of America. 32. Mycological Society of America. 33. Poultry Science Association. 34. Society of American Bacteriologists. 35. Society of American Foresters. 36. Society for Experimental Biology and Medicine. 37. Soil Science Society of America. 38. Sullivant Moss Society. 39. Union of American Biological Societies.

priate boxes to the national technical societies in whose hands to a large extent lies the professional guidance of those arts and sciences by which man produces his food and the organic raw materials which he uses in his civilization.

To point out that the products of the soil constitute the most fundamental and the only really essential factors in man's existence is to state a truism to which there is no occasion to call your attention. The chart is presented, rather, to emphasize the complexity of the problem of organization which is faced by biology, using that term in its widest sense including its applications.

The outstanding feature of biology and agriculture, and it must immediately occur upon any consideration of these fields, is the number and diversity of the organizations included in the group. Whereas chemists of all sorts support one strong chemical society, biologists have set up a number of weak societies. The problem of organizing biology and agriculture is altogether too similar to that of consummating the consolidation of the several weak Protestant churches frequently found in a rural community.

In its bulletin on "Industrial Research," p. 250, the National Resources Planning Board gives an organization chart for physics in America. It is neatly set forth in seven boxes, which include the national societies and culminates in the American Institute of Physics. Probably physics is oversimplified by this chart. But could anybody reduce biology and agriculture and their societies to similar simplicity? The representation of our field in the 31 boxes used in the chart has, in fact, required considerable compression and generalization and the omission of many important relations.

A proper organization chart which shows by straight line connections, dependence and responsibility is impossible for our group. One could so connect entomology and crop protection, for instance, but medicine and animal protection also are similarly dependent on entomology, and if the application of each of our sciences were thus shown our chart would become an unintelligible mass of crisscross lines. Several of our sciences have such varied responsibilities that the connections of each would make a spiderweb reaching into almost every box on the chart. On the other hand, most of the applied fields draw from a wide variety of underlying sciences. Forestry, for instance, depends on all but one of the sciences placed higher on the chart. In view of this complexity it was impracticable to show connecting lines but, instead, some of the interrelations were indicated by arrows. For example, an arrow from forestry toward raw materials suggests the chief function of forestry, but there was no opportunity even for suggesting other important functions of forestry such as controlling erosion, harboring wild life and providing recreation areas.

The fact is that any adequate representation of our group would require for almost every member a separate organization chart, only less complex than that presented for the whole. But separate charts would necessarily leave off the interconnections between the different fields and our problem lies exactly there, for these interconnections are fully as important as the special responsibilities of each science.

The writers of the bulletin on "Industrial Research" made some rather sharp criticisms of our field, pointing out that biology has not won anything like the acceptance in industry that has come to the physical sciences. They recommended that we establish an "American Institute of Biology" comparable to the Institute of Physics. If this were construed to mean that biology has not rendered as great practical services as have the physical sciences, it would be quite incorrect. The great public institutions, state and federal, devoted to scientific agriculture through the applications of biology have no counterpart in the physical sciences. The "colleges of agriculture and mechanic arts" contemplated by the Morrill Act have, in fact, gone much further in agriculture than in engineering. One reason why industrial concerns have few biologists on their staffs is that, whereas they know they must pay for consultants in engineering, they expect to get expert advice in agriculture for nothing from government employees.

Whether a system of private-paid or of public-free consultants is better public policy is a large question into which there is no occasion to enter here. But regardless of the merits of this question, there can be no doubt but that the man who collects fees of a hundred dollars a day holds himself in higher esteem and is more highly regarded by his neighbors than the man who renders the same service gratis. Biologists would strengthen both their own self-esteem and the standing of their professions if they curtailed the consultation services they render without compensation. In the case of men attached to public institutions, it would increase the prestige of both man and institu-

tion if fees were charged for their consultations. The fees might well go into the institutional treasury if the institution gave proper recognition to the value of its men by way of salary adjustments. The biologists who are called into consultation find upon rubbing shoulders with engineers employed in the same way that, both in ability and in the value of the services they can render, they measure up to the engineers.

Two other important differences between physics and biology are manifest. First, despite the complexity of modern physics and the disappearance of the old frontiers which used to separate it from chemistry, the physicists have developed a strong guild consciousness which brings to them a sense of solidarity not possessed by biology.

The chief influence which pushes us apart is the necessity for diversified specialization. It is clear that there can be little common understanding of details among our different fields, *e.g.*, forestry and veterinary medicine; and it is equally clear that there is no possibility of important progress in any scientific field except by concentration on comparatively limited objectives. Is, then, our case hopeless? I think not. The same degree of specialization is necessary in physics or in chemistry, where its disruptive tendency is greater by reason of the vastly larger number of entities with which chemistry must deal. But physics and chemistry both retain an esprit de corps and a guild consciousness which hold them together. The source of this unity lies, I believe, in common points of view.

Is there, latent, enough of a common point of view among all the groups associated under biology to bind them together with a degree of unity far beyond that now realized? I would not presume to answer this question in its entirety, but I think any biologist, figuratively looking out of the box in which he is placed in the chart, will recognize at least that he has much more in common with the people in neighboring boxes than is given expression to in our organization.

Second, the organization of physics does not include the applications of the science in engineering. In view of the manifest advantages to both physics and to engineering of their separate organizations which permit each to make its own distinctive contribution, it might be concluded that biology and agriculture should forthwith be similarly separated. Such separation looks right logically and will probably be desirable — ultimately. But in my opinion separation of agriculture from biology at the present time would be unwise. Biology is contributing so much to the development of agriculture and agriculture is stimulating the advance of biology so greatly that both would lose by separation at this juncture. Indeed I believe it can be demonstrated that a closer integration would increase the progress of both for some time to come. If this be correct, we should use every means to bring the two closer together.

The need for integration between biology and agriculture is increased by the war, for war at once puts greater emphasis on the practical and makes greater demands for innovations and these must be based on the principles of pure science.

Belief that a strong organization of the biological sciences would be advantageous is in no way novel or original to the writer. Some years since, the Union of American Biological Societies was organized and more recently the American Biological Society was launched. Both have been primarily concerned with promoting *Biological Abstracts*, a highly desirable project in itself but no adequate objective for such far-reaching organizations. Their initiation was indeed something like putting the cart before the horse. A strong federation of biologists would certainly feel the need of an abstracting journal and would support one. But such a journal can not create a federation.

I believe that all branches of biology (in the broadest sense) realize to some extent the advantages that would accrue from a strong federation of biological interests and, I think, all elements if properly treated will go along with steps to develop the bonds supplied by our many common interests. But such a living organization could not be produced by fiat. The present paper is submitted as an analysis of our actual situation. It does not include a program of action. It is my feeling that any changes in the relationships of our constituent groups will have to grow slowly and that to a large extent they will have to be initiated by the groups themselves.

Is it worth the great effort which will be required to federate the biological sciences? What may be expected from the life sciences in the years to come? During the past century the physical sciences have transformed our environment by producing all sorts of mechanical conveniences which have freed mankind from the long hours of

toil before required to produce the bare necessities of existence. Among the life sciences this last century has been a time of preparation. We have learned how to protect man from many of the diseases which heretofore carried him off before his time. We have learned much of heredity and of the principles which underlie the production of improved domestic animals and crop plants. We are learning through the application of the new science of nutrition that man properly nourished maintains a vigor in life never before thought possible.

Such things have been slowly emerging through the period that is closing. The years ahead will see applications of biology to the betterment of human conditions such as we can now hardly imagine. This development will require all the detailed specialized technical tools that we possess — but more, it will require broad insight and applications of biological principles to world problems by men of affairs. Will the professional biologists play their rightful roles in this future, or will they barter their heritage for a mess of specialties?

Specialists often fail to recognize the bearing of advances in cognate fields on their work. If there were some way of bringing home to them their own need of relating their work to fields other than their own, the problem of the organization of biology and agriculture would be well on the way to solution, for there would be a spontaneous desire to bring together information and ideas from fields at present sharply separated. One trouble is that it is so much easier to follow developments in one narrow line than to keep abreast of advances along a wide front, and men will follow the line of least resistance. But lines of specialization are soon worked out and the men who survive have to shift into other lines. To adjust himself successfully to changing conditions, a man needs the broad outlook which can be most readily maintained by diversified contact with several fields.

Several correspondents have given the opinion that biologists are suffering from an inferiority complex and that this is one of the causes of our difficulties. It was partly with this idea that I suggested above the advisability of more paid consultative work by biologists and agriculturalists. Certainly it is advantageous for men in academic circles to have contacts with men of affairs. College and university men are too used to being taken care of by their institutions. We need to learn better to take care of ourselves, and in so far as we do so we will command a larger place in the scheme of things.

There are two main and fairly distinct, though considerably intertwined, avenues by which biologists serve society. These are in addition to the less direct general educational services that come from the cultural values of instruction in biology, which our fields share with other sciences, arts and letters.

The first and oldest of these two services is as preparation and background for the medical sciences. In the old days before the development of scientific medicine all of biology contributed thus to medicine. In the beginning the physician had largely to gather his own drug plants and so the early botanists were physicians who had specialized into a knowledge of plants. This was true of most of the old herbalists, of LINNAEUS and of ASA GRAY.

But the rise of pharmacology, which proved that comparatively few of the old herbs possess important therapeutic value, and the achievements of synthetic chemistry which produce more and more drugs in the laboratory took away the practical value of the old herb doctor's botanical lore. Thus botany came to play a minor part in medicine.

By this development botany was deprived for the time being of its chief professional outlet. At the same time the rise of comparative anatomy, embryology, physiology, and especially of experimental zoology, accompanied by the researches in medicine itself which led to the establishment of scientific medicine, greatly increased the importance of zoology to medicine and gave a greatly enlarged outlet to students of zoology. The improvements brought about in the treatment of disease likewise vastly expanded the opportunities for service in medicine and increased correspondingly the number of physicians. The training of recruits to the army of physicians, which now numbers above 150,000 in this country alone, is in itself a very large undertaking — large enough to absorb the energies of a considerable body of men.

Thus it has happened that, without looking beyond medicine with its preparatory and cognate subjects, the zoologists have found an abundant, profitable, and useful scope.

This is not to charge that zoologists have limited their activities in any narrow way to medical interests. The reverse is quite generally the case. Very often the zoologist whose students go largely into medicine undertakes researches as far removed from medical application as possible. But the fact that medicine is the destination of the majority of students who take zoology has given that science a bent which produces the largest element of disunity in our organization as may be seen by observing how the zoological and medical aspects of biology stand apart from the agricultural in our chart.

While zoology* has benefited very greatly by thus having an outlet for service through medicine, it has also suffered the loss through that outlet of many of its best men. Every teacher of zoology knows that many of the students best fitted to become zoologists go into medicine. If the pull of the medical sciences were not quite so strong, zoology itself might be stronger. If opportunities for placement of zoologists in premedical fields had been less, zoology might have entered more completely into the whole of its domain. As it is, it has left large segments of the animal sciences to be developed by other hands.

Both zoology and agriculture have lost by this separation. There are, for instance, among the zoologists many able geneticists. Their achievements in discovering and formulating the laws of inheritance have been outstanding. Among them is the only American biologist who has been awarded a Nobel prize. Few of these men, however, are in touch with the Society for Animal Production. Out of roughly a thousand members of the American Society of Zoologists only eleven are also members of the Society for Animal Production. Perhaps it is a direct consequence of the separation of these interests that during the four decades in which the Mendelian Theory has been available, animal breeding has brought forth no achievements comparable in economic returns with hybrid corn or even with the large number of polyploid flowers and fruits recently produced by plant breeders.

By all the logic of the natural relations of subject matter zoology should be as much interested in parasitology, entomology, veterinary medicine, animal production, animal breeding and animal ecology as in medicine. But as a matter of fact, zoologists have been so much occupied with premedical interests that the agricultural animal sciences have been largely left to Experiment Station workers, and there has been little community of interest between the two groups.

It is not intended to suggest that the same individual could attain proficiency in more than one branch of science. The significant thing is that the organizations of the two groups of animal sciences have drifted apart. Perhaps the most striking illustration of this divergence is that between zoology and entomology. Entomology grew up in the service of agriculture even more than zoology and medicine have grown together. While the American Association of Economic Entomologists was founded in 1889, it was not thought necessary until 1906 to foster the development of the science itself, as distinguished from its applications, by establishing the Entomological Society of America. Although insects are as much a part of the domain of zoology as are marine invertebrates, the members of the American Society of Zoologists have concerned themselves very much more with the latter than with the former. Students of marine invertebrates are sufficiently at home in that society that they have not set up a specialized society of their own comparable with the entomological societies.

But while students of other groups of invertebrates are generally members of the American Society of Zoologists, the entomologists generally are not so affiliated. Less than one per cent. of the Association of Economic Entomologists and only six per cent. of the members of the Entomological Society of America are members or associates of the American Society of Zoologists.

In the early days of their development both botany and zoology prided themselves on being "pure" sciences and disdained applications to industry and agriculture. Finding adequate outlets in the development of the medical sciences, zoology has maintained this position, though with little of the "holier than thou" attitude with which both botanists and zoologists regarded applied scientists forty years ago. To this day, however, comparatively few members of the American Society of Zoologists are pro-

* Perhaps I am using zoology in too narrow a sense here. For present purposes I am drawing my definition of the science itself from the objectives and attitudes of the American Society of Zoologists, which I recognize is not an entirely fair procedure. Yet, that ought to be the proper way to find out the nature of zoology.

fessionally engaged in applied science. So far as medicine is concerned, the separation of the pure sciences underlying the applied medical arts has been enforced by strong professional esprit de corps among physicians as well as among zoologists.

Botany, however, was compelled to take a different course. Deprived of its original usefulness by the decline of the herb doctor, botany found itself without adequate outlet for the energy of its devotees or their students. It was forced to make itself useful to agriculture. With the passing of time that connection has broadened and strengthened to the mutual advantage of both participants.

It is instructive to remember that in the beginning botanists were as much traditionally opposed to economic work as any other scientists. One of the ablest of mycologists, for example, who was forced in his youth to accept a position in an Experiment Station and there made an outstanding contribution toward the control of potato scab, always as long as he lived professed to be ashamed of this work and devoted the balance of his life to the study of fungi with no possible economic importance. But this man stood alone for many years before his death and a large majority of his students took up economic work. Again the extent to which the integration of botany and plant pathology has gone may be judged by the fact that of the total membership of the Phytopathological Society, approximately 20 per cent. maintain membership in the Botanical Society of America.

The most significant advances among the plant sciences during the last decade have occurred in plant physiology. Here more than anywhere else the interdependence of pure and applied science has been manifest. As long as plant physiology remained a pure science confined to old line university departments of botany, it never amounted to much. Indeed beans and corn were about all the materials used and the work did not get beyond the demonstration of a few simple principles — just enough to show that the subject had potentialities.

But when agriculture began to ask questions about the scientific basis of plant production and coupled these questions with appropriations for their answer, plant physiology began to advance. This at once brought into high relief our lack of understanding of the fundamentals of that field. As a result the science itself has evolved, up to now, rather more than its applications. But within the last few years these advances in fundamentals have permitted applications of rapidly increasing importance, starting a development which bids fair to become one of the most important in all biology.

Because of its importance to medicine, bacteriology is closer to zoology than is any other of the plant sciences. There are, indeed, about as many teaching positions requiring a combination of bacteriology with zoology as with botany. But bacteriology in its own right is no more a medical subject than is chemistry. Like chemistry, its applications reach into almost every field of biology and agriculture. It was impossible, therefore, adequately to represent its relations on our organization chart. Unlike chemistry, however, bacteriology has permitted the importance of its applications to dwarf the growth of the science itself. A parallel situation would be presented if chemical engineering had attempted to advance without physical chemistry. It seems likely that if the bacteriologists could set aside some of their best men to develop the pure science of bacteriology for its own sake, the fundamental principles so brought to light would lead to greater applications even than those which have been made already.

Physiology is in many schools merely *human* physiology. There is very slight contact between the physiological departments of medical schools and *plant* physiology. Yet in its fundamentals physiology has as broad an applicability as any of the biological sciences. Many have emphasized the importance of *general* physiology and most agree that it ought to be widely taught, especially for the broadening of men preparing for medicine, but it has never flourished. The reason lies probably in the bias of the premedical students who flood our biology departments. They are continually pressing for courses more and more nearly similar to the medical work to which they look forward. Most medical schools as well as most departments of biology deplore this tendency and would be glad to compel premedical students to broaden the biological base on which to build their medical work. But they have not been strong enough to force the students into the preparation which would be best for them, and in this situation general physiology has languished.

Biochemistry, perhaps even more than physiology, is properly a field of general biology. But many departments of biochemistry instead of representing the fundamental science are mere adjuncts of medical schools. At the other extreme "Agricultural Chemistry" developed independently, starting from very narrow applications of chemistry to fertilizer analysis and such practical matters. Happily the progress of the science has brought about considerable rapprochement between the agricultural and the medical biochemists, but there is still far too wide a gap between them. Like physiology, biochemistry is in its nature more properly a pure science which (like physics) should be strongest in universities, rather than an applied science (like engineering) strongest in technical schools. In suggesting this I am not pleading especially for the pure sciences, for I believe it can not be gainsaid that strong departments concerned with these sciences for their own sake would extend and increase the usefulness of their applications.

The scarcity of departments of pure physiology and of pure biochemistry is sufficient evidence that the biological sciences in the universities are not strong enough to stretch out and occupy all of the fields of biology which should be cultivated. They need help here from the applied branches. Agriculture and medicine should unite in demanding that the universities establish departments of physiology, of biochemistry, and of bacteriology to prepare students for the technical schools with no more emphasis on applications than is given by university departments of physics preparing students for the engineering schools. If this were done, all biology would be greatly strengthened. The corresponding departments in the technical schools would find their own hands strengthened and would grow into an increased usefulness which would be hard to envisage at the present time.

All biological sciences spring from the same root. They are like a tree with many branches. Some of the branches, however, have grown so vigorously and reached such distances from the trunk that they have forgotten their origins and consider themselves independent trees. This analogy is due to C. V. Taylor of Stanford, a zoologist, who is distressed by the degree of separation that has developed among the different members of our group. Taylor points out that all living things are made of a protoplasm which, despite the widely diverse types into which it develops, remains on the whole surprisingly uniform in fundamental character throughout. The laws of its evolution and of its inheritance are the same everywhere. To a very large degree even its cellular structures are constant.

In so far as the analogy of the growing tree is applicable, it will be recognized that it is just those branches which grow most vigorously that get farthest away from the main trunk. Also, in the tree there is dead wood and there are rotten branches which may not be detected until stress and storm search them out. Likewise, on a tree leaves which almost touch may draw their sustenance from different branches which may have grown independently for a long time so that the only way to get from one to the other is to go clear back to the root. In the tree the original connection to trunk and to roots is essential. If it is severed at any point, every part beyond the cut dies.

The question really before the assemblage of sciences now grouped under biology and agriculture is whether we are comparable to a tree with a single trunk or whether we are more like a bush with many trunks from the same root. If we are like a bush, the health of any one branch is of little concern to the others. Indeed, when a branch is cut out of a bush the others grow all the better, profiting from the removal of competition. But if we are like a tree, then it behooves us to look after the health of the trunk that supports us all.

Is biology like a bush or is it like a tree? The question can be answered with assurance only with the passage of time. It is permissible, however, to make one observation: Bushes rarely attain any great height and they are mostly shortlived. The really tall and permanent growths are all trees.

● **Botanical Progress — An Editorial of Fifty Years Ago** (the late J. M. Coulter *in his* Botanical Gazette 19:160-161, 1894*): — There are many advantages in being in the current of the world's activity. Botany is restrained in its development, and

* This quotation and some other 'Coulteriana', which I reprinted recently in my *Introductory Essay* to 'Plants and Plant Science in Latin America', may be of especial interest to readers of Rodgers' "John Merle Coulter" (Princeton U.P., 1944) (*Editor's Note*).

shorn of just recognition, because its representatives are still largely willing to paddle about in quiet bayous, content with the richness of botanical materials and the opportunity of uninterruptedly studying them, without giving a thought to the great interests involved in the surging, pushing mass of commerce and daily traffic which pass near by, accompanied by the noise of enginery and the display of competition. A well known botanist, who has occupied a public position for many years, explained to the writer some time ago that he preferred to go without much needed facilities in the way of books, room and assistance rather than make a request for them or do anything that would attract the attention of the politicians, who would probably abolish the office or bring about some calamity if they remembered that he was in existence. This feeling is a survival from the old days when the botanist was a scholarly recluse, and neither he nor any one else dreamed that his knowledge could have a cash value. Botany was taught then, and is often taught now, as Arabic or quaternions are taught, not because it would help one to gain a livelihood, but for its disciplinary and educational value.

A mighty change has overtaken the spirit of the botanist in recent years. He has emerged from his herbarium den, and looks at the world with a clear eye instead of constantly peering through a magnifier at a bit of unrecognizable vegetation; he is occasionally seen in cultivated fields, instead of prowling through thickets and out of the way marshes; he speaks like a man who is watching for an opportunity to develop a new industry, and no longer acts as if he fully believed that industries and botanical science are unrelated and incompatible.

But the transformation is not complete, in fact it is only so far along as to make its tendencies clearly recognizable. There are still good botanists who will not admit that there is any actual change. They are content that the study of the food of plants should be carried on by chemists, the investigation of the laws of breeding and practical treatment of diseases by horticulturists, the relation of plants to heat, light and electricity by physicists, the study of bacteria by pathologists, the examination of fossil plants by geologists, and so on. In repudiating the connection of these and other lines of investigation with the science of botany, especially where a practical or commercial end is in view the botanist loses the advantage derived from popular approval. It is more difficult to obtain ten dollars to equip a laboratory for vegetable physiology than a thousand dollars for a laboratory of chemistry, because Baron von Liebig and others long ago fully convinced the popular mind that a knowledge of chemistry was essential to an intelligent pursuance of most of the arts and industries. And so thoroughly was this done that every man, even to the present day, although he may not know the names of the elements, associates chemistry with the indispensable in education, while he has hazy, if any, notions about vegetable physiology or its application. A Liebig is needed in botany.

It is a sound principle in advertising that having an article of genuine worth and general utility the profit from it will be in proportion to the extent to which it is made known. Botany, both as a fundamental and as an applied science, is in some respects like a commercial article. The better its merits are known the greater its income will be in the way of money for teaching equipment, for laboratories, for research, for salaries, for assistance, the more and varied the demand for botanists, in short the greater activity and the greater possibilities.

The progress already made toward creating a need for botanists in the commercial world is considerable, and is every year increasing the demand for well trained men. At present the most promising field is vegetable pathology. In this line the action of the orange growers of Florida is significant. They have endorsed and substantially aided the Sub-Tropical Laboratory at Eustis, and recently have formed a stock company to send a botanist around the world to collect and study citrus and other sub-tropical fruits, to observe their diseases, and in every way possible to make available whatever knowledge an able botanist can gather with practically unlimited resources. A method of caring for orchards and vineyards, likely to be introduced by some enterprising community, is the employment of a pathologist to take charge of the health of the plants, spray them at suitable intervals, and to be on guard against parasites. There are at present many ways in which botanical knowledge can be made to yield a livelihood beside teaching. The greater and more diversified the de-

mand for men trained in botany becomes the better it will be for all branches of the science, and for all its devotees.

● **Washington during the First World War—1917** (DAVID FAIRCHILD *in his* "The World was my Garden", pp. 458-464, New York: Scribner's, 1938—reprinted by kind permission of the publishers) : — Washington was seething with excitement. War was declared on April 6, 1917, and DORSETT and I were already at work arranging a war budget for the Office. No one can adequately describe the confusion of those early days, nor can I look back at them without a shudder. The wild disorder; the hundreds of futile plans to stimulate food production by increased farm acreages; new methods for prevention of plant disease; the cultivation of drug and oil plants made necessary by the shortage of foreign supplies — all these come back as unpleasant memories.

Almost immediately I found myself in the center of a Dried Vegetable Campaign, and discovered that really nothing definite was known about the drying of even our common vegetables. Frantically I evolved a homemade drier with which MARIAN and I dried vegetables on wire trays over the kitchen stove. Photographs of this crude apparatus were published by the Department and broadcast over the country, although the resulting product was discolored and poor in quality. The difficulties in persuading people to eat these poorly dried vegetables were almost insurmountable. I took a hand in the propaganda to encourage their use, arranging, among other things, the details of a moving-picture film staged in Mrs. LANSING's back yard, in which five ladies of the Cabinet were shown eating with assumed delight a luncheon of dried vegetables, dried fruits, and dried meats.

I learned much about the food habits of people from this campaign. For example, I discovered that unless people's attention was especially attracted to the vegetable they were eating, they would eat it without dreaming that it was a dried product "brought back" by soaking overnight in water. However, if they were urged to eat dried vegetables, they would vow they could never bear to touch such things.

I had many amusing experiences with the manufacturing firms and canners, as for some time I was their contact with the Departments. They all believed that the boys at the Front ought to be using dried vegetables, but in this they were balked by HERBERT HOOVER as well as by the officers of the Commissary Departments. Both HOOVER and the War Department refused to give dried foods the benefit of the doubt.

The campaign had not been under way very long before E. CLEMENTS HORST, the biggest hop grower in California, arrived in Washington with a carload of dried vegetables which he had prepared in his hop kiln. He walked into my office one morning with the declaration that he had come to get President WILSON to eat his dried products, and that he would then launch his propaganda with this news. Knowing something about the President's food habits, I smiled, and told HORST that I thought he would have an uphill job.

When he found that he could not get to the President, he decided to give a big dried-vegetable luncheon at the Willard, and asked me to assist him in lining up the Bureau chiefs whose conversion he thought desirable. He was particularly concerned that the Food Administration be represented, since its attitude towards dried vegetables had been apathetic, to say the least. Of course Mr. HOOVER would not come, I knew that, but I had met Miss ETHEL BAGG, who was very active in the organization and who, I thought, had influence with Mr. HOOVER; so I persuaded her to represent her chief.

HORST had twenty-six different kinds of dried foods but they bore little relation in quality to the superior products turned out only a year later. In fact they were rather poor stuff. I strongly advised him against serving more than two or three vegetables at his luncheon, but the morning of the affair I saw him marching off towards the Willard Hotel with an armful of packages containing the whole twenty-six varieties. Being dried, they weighed so little that he could easily carry enough to feed his forty guests.

A notable gathering of chemists, Army and Navy men, Red Cross workers and dieticians assembled. From the very outset I was anything but happy, for it seemed to me that the waiters grinned sardonically as they served the first course, although it was really a good vegetable soup. The reason for their amusement became apparent when they began to pile the various vegetables around the individual steaks which followed the

soup. Dried spinach, corn, potatoes, carrots, beets, cabbage, parsnips and all the others. Over this extremely unappetizing array of strange-looking foods, was poured an inky fluid as a finishing touch. This was a preparation of HORST's dried mushrooms.

After the luncheon, most of the guests politely lied about it, not wishing to hurt their host's feelings. But some of them disappeared without saying anything.

HORST arrived at my office the next morning glowing with enthusiasm about the success of his luncheon.

"How did HOOVER's representative like it?" he asked.

I called Miss BAGG's office on the telephone and was told the devastating news that the representative of the Food Administration had returned to her apartment from the luncheon so nauseated she had thrown up all of HORST's twenty-six dried delicacies.

However, all this took place early in the campaign. Before the end of the War, the big firms were turning out excellent products by using low temperatures and powerful fans to carry off the moisture. So successful were the results that vegetables thus dried could be "brought back" by soaking overnight, until, when cooked and served, they approximated canned or even fresh vegetables.

The closing banquet of this campaign was a very different affair from poor HORST's dismal luncheon. The long table was spread with an amazing variety of dishes which had been prepared with such skill that many of the guests had no realization that they were eating dried vegetables at all. There were creamed spinach, stewed tomatoes, beautiful white mashed potatoes, string beans, and even corn on the cob, none of the vegetables revealing more than faint signs of having had any but the most usual history.

Really, the argument for dried instead of canned vegetables was a logical one. Dried vegetables save space, weigh little, and keep almost indefinitely, reducing the freight and storage problem tremendously. But all these arguments meant little to cooks and housewives who did not want to learn new methods of cooking and were influenced by the newspaper ridicule of the idea. However, I still believe that, had the War lasted longer, a number of the dried products would have become permanently established on the market. As it is, only the mixed vegetables for soups seem to have survived except for campers and expeditions which stock up with desiccated foods to save bulk and weight. Certainly whatever products there are today are as good as they are because of the work and research accomplished during the War.

During the autumn of 1917, the work with dried vegetables took me to Doctor McCULLUM's laboratory in Baltimore where he was feeding fifteen hundred rats on a diet similar to that being used by one of the orphan asylums. The diet, largely composed of cereals, had proved so defective that it had produced disastrous effects on the rats. As a result of his researches, McCULLUM had discovered the presence of a new substance in green, leafy vegetables which was essential to animal life; a *vitamin* which he called "Fat Soluble A." It is also present in butter fat and certain fats of the animal body, and he was already beginning to stress its importance, an importance which has since become universally recognized. McCULLUM complained that he had no facilities for photographing his half-starved rats in order to show the results of his experiments. I therefore sent CRANDALL, the photographer of our Office, over to Baltimore and he took the photographs for one of McCULLUM's earliest publications.

As the German submarines threatened our communications with Europe, it appeared possible that we might not be able to provision our troops adequately from this country. Consequently, it was proposed that sweet potatoes, one of the biggest yielders of all starchy vegetables and one easily propagated, should be grown extensively in southern France or Morocco. A shipload of American farmers familiar with the cultivation of sweet potatoes was to be sent over, equipped with tools and roots.

I was instructed to consult Ambassador JUSSERAND and find out whether this suggestion were feasible. When I called at the Embassy, I found him much excited, for one of the projectiles of the Big Bertha had landed near his home on the Champs Élysées the day before, and the mystery of the big guns was still unsolved and alarming everybody.

I told him about the scheme to grow sweet potatoes in France. He listened attentively and then remarked,

"You propose to grow these sweet potatoes for the American troops, do you not? For I must tell you that my countrymen will not eat them. One was put on my plate at a dinner in Washington the other night. I ate it. But I would never eat another."

When it was found that our convoys succeeded in passing safely through the U-boat zone, the plans to grow food on the other side were abandoned. However, this revelation of a food prejudice attributed to an entire nation made a great impression on me. It was one of many which were forced upon my attention during the War. Another example was corn-meal. All attempts to get the Food Administration to send corn-meal to the Belgians failed. Mr. Hoover knew their prejudices against it. Doctor L. H. Baekeland, the inventor of Bakelite, was born in Belgium, and tells me that many Belgians consider one of the greatest sacrifices which we Americans made during the War was that we used potato flour and corn-meal so that there would be wheat flour enough for the Belgians.

Another wartime undertaking in which I was involved catered to something more substantially concrete than public taste, in other words, to the chemistry of gases and carbon.

When poison gas was first used, there were of course no gas masks, and the destruction of human life was appalling. Immediately, man's inventiveness was called upon, and the chemists developed the application of a well-known principle called "occlusion." In other words, certain gases are absorbed by the surface of porous objects such as charcoal. The gases have the property of adhering to the surfaces of the charcoal, and when the poisonous gases used in the War were breathed through charcoal, it filtered out the poison gases and let the air pass carrying its oxygen to the lungs. At the outset, I believe that any kind of charcoal was used, but it soon was discovered that the finer the grain and the denser the charcoal, the more efficient it proved as a filter. Charcoal made from peach kernels or coconut shells had many small cavities and presented a greater surface area to the gases. At least, this is a crude picture of the process.

This discovery started the gas experts on a search for palm seeds to use in making charcoal, and they turned to us for assistance. We immediately embarked on a wide enquiry based on the palm and other seeds in our seed collection. As our inventories were completely documented, we knew where the various seeds occurred. Any dense, hard seed of sufficient size made a suitable charcoal. The coconut proved the best, with peach and apricot pits as second choice, and after them some of the rarer palms such as that of the West African oil palm and various palms of the great Amazon basin. Later O. W. Barrett, who had been a member of our staff, was sent to some of the tropical countries to round up a comprehensive supply of palm seeds for the gas-mask service. This world-wide search for the best seed for charcoal illustrated the importance of our collecting data regarding the plants of the world even before they were as yet on any obvious program.

Nothing connected with our activities during the War was more irritating than the utterly futile and uncalled-for attempt on the part of the War Department to turn agricultural themselves when they wanted castor beans for the Aviation Service. Brushing aside the Department of Agriculture, they undertook to stimulate the growing of castor beans through their own organization. Employing men who might know something about haberdashery but certainly knew nothing of plants, the War Department developed a program to encourage farmers to grow castor-oil plants without ascertaining the requirements, climatologically or otherwise, of their culture. All they knew was that castor-bean oil was essential for the lubrication of the Army aeroplane engines.

I naturally had nothing to do with the matter, but had opportunity to discover the caliber of some of the men in charge. I met one specimen when I was on my way to Moore Haven, a new settlement on Lake Okeechobee, Florida. As the boat pulled out of West Palm Beach, a man stepped on board who had the earmarks of a ward politician. My companion pointed to him. "There is the man sent here by the War Department to tell the farmers how to grow castor beans," he said, "He is going to make a speech."

This being the case, I thought it behooved me to make his acquaintance. I soon found that he barely knew a castor-bean plant when he saw one. When he discovered that I did, he tried to make me back his program of castor-bean planting in the Ever-

glades. I asked him where the seed he was going to distribute had come from and whether it was adapted to Everglade soil. Apparently the seed was a job-lot from somewhere in India (he did not know where) and he had no evidence that castor beans would fruit satisfactorily on the muck lands of the Everglades even if they grew at all. I soon edged away from him and let him go his uninformed way, since there was little that I could do to prevent what I knew would be a fiasco. I did urge the planters at Moore Haven to investigate the situation carefully, as the outcome was a gamble with the dice loaded for failure.

Of the complete collapse of the castor-bean program and the lawsuits which the farmers filed against the War Department for supplying poor seed and causing them to lose time and money, I prefer to say nothing. It was just one of the many ill-advised schemes hatched during the War. (It was a fact, I believe, that the man in charge of the program really was a haberdasher.)

● **Problems in the Nature and Control of Tropical Deterioration** (presented by WILLIAM H. WESTON, Professor of Cryptogamic Botany at Harvard University, at the meeting of the American Association of Textile Colorists and Chemists at Atlantic City, N. J., October 14, 1944, published *in* the American Dyestuff Reporter 34:91-93, Feb. 26, 1945, and reprinted here with permission of the AATCC): — The broad general problem of tropical deterioration is so complicated in character and so extensive in scope that it touches the interests and activities not only of this association but also of many other groups in civilian phases of the war effort and in the army and navy. During the past two years the problem has made itself felt increasingly until it has aroused general and wide spread concern. This does not indicate that the problem itself is a new one for it is one of long standing; rather the indications are that changes in conditions involved in large scale military operations in the tropics have introduced additional factors that have notably increased its severity. The most important of these factors are the following:

*1.* Vast amounts of material, valuable in itself, doubly valuable because of the cost of replacement, and triply valuable because of its importance in military operations have been exposed to the most severe conditions.

*2.* Much of this equipment is infinitely more complicated than anything so exposed in the tropics in the past, its construction in encased assemblies precluding adequate care of essential but susceptible parts, its precision requiring maintenance of delicate adjustments.

*3.* Field operations requiring establishing tropical beachheads and fighting toward the interior have of necessity involved very severe conditions of exposure.

*4.* The urgency of these military operations has prevented giving adequate protection to some items for weeks or even months.

Since textiles are the primary concern of most of us here, the general problem of tropical deterioration may best be considered in relation to them. The severity of the conditions to which heavy textiles like tentage and tarpaulins are subjected is extreme. After manufacture, finishing, and fabricating they have undergone long periods of storage and transportation. The long journey across the Pacific in the hold of a vessel has involved extremes of temperature running as high as 150° or 160° F. in an atmosphere usually sufficiently moist to permit some droplet condensation during rapid changes. After further handling and transportation the material has reached its destination often under the severe conditions of combat landings noted above. Finally the tent is pitched and its exposure to the tropical environment officially begins.

While this tropical environment varies considerably in different localities, its two ever present components, the climate and the many organisms fostered by the climate, form a combination that is, in general, severely destructive. While the temperature is relatively even, ranging from around 78 to 95° F. in the shade, it may drop at night to as low as 70 or even 65° near forested mountains and during the day, if in the sun, the tent will be baked at 140 or 150° during several hours. It will be surrounded by air with a relative humidity from 85% to saturation and during the rainy season it will be beaten by torrential rains amounting to as much as 200 or 300 inches in six months, with little if any chance to dry out. Even when not subjected to such extreme downpours, it will be dripping wet in spots as slight changes in temperature

result in condensation particularly in the inside in the peak of the tent where ventilation is not adequate, and it will be damp to dripping inside and out most of the night. In the monsoon belt, if pitched in the open along the seashore or on the coastal plain, it will, through the several months of the dry season, be sun-baked during each day and damp by condensation each night. In the dense, dank jungle of the real rain forests it will be unremittingly damp to dripping throughout the year. It will be surrounded, besieged, and attacked by unresting hordes of hardy and aggressive lower organisms, some actively destructive, some slightly detrimental, some neutral, but all well adapted not only to survive but to thrive and multiply under tropical conditions. To some of these it will furnish food, to others sheltered hiding and breeding places, to still others highways, points of vantage, and flying fields. From the air, from dust, from material splashed, dripped, or dropped on its surfaces, vast numbers of spores or other microscopic reproductive bodies of various low forms of plant and animal life will be deposited to hatch or germinate and start their rapid growth. Thus even on its upper panels it will accumulate a microscopic but fertile soil while through contact with the earth as well as from spattered mud it will acquire some of the multitude of soil organisms that constitute the most complex microbial population known to science.

In this complex of environmental factors, both non-living and living, lie the causes of tropical deterioration. In part the chemical and physical factors of the non-living environment are responsible, and one school of thought considers these to blame for practically all of the trouble encountered. The other school of thought considers the living agents, chiefly fungi and bacteria, secondarily insects, mites, and other lower animals, either separately or in sequences and combinations, as primarily responsible and offers strong supporting evidence by experimentally reproducing severe deterioration with such organisms under controlled conditions. In my opinion the evidence now available justifies the conclusion that at least in the case of textiles derived from plant and animal raw materials, textiles such as the cotton duck we are considering, deterioration results chiefly from the action of fungi and bacteria.

This conclusion leads us to the consideration of subsidiary problems such as the original source of these agents destructive to cellulosic textiles, and the identity and characteristics of those causing the destruction of such textiles in the South and Southwest Pacific theatres.

The source and origin of the fungi attacking cellulosic fabrics is fairly clear. They are, in the main, saprophytic, decay producing molds and mildews originally occurring on leaves, stems, and other cellulose containing plant remains. This general situation is one of long standing for cellulose and its derivatives developed early in the evolution of the plant kingdom and have continued ever since as the main structural constituents of plants, while certain fungi, early in evolutionary history developed the ability to use these carbohydrate materials as their chief sources of carbon. Thus fungi have played an important part in nature for millions of years in breaking down complicated plant remains, rendering the constituents of cellulose once more available in simple form in the vital cycle of organic materials, and thus from the broad biologic viewpoint they have been beneficial to man as well as to other living things. This breaking down of complex materials to simpler components as sources of their carbon, nitrogen, minerals, and other raw materials is an essential step in the nutrition of all fungi and is accomplished by the batteries of powerful enzymes, the production of which distinguishes the fungi as minute chemical factories of the highest efficiency, versatility, and diversity. Obviously the organisms chiefly responsible for tropical deterioration for millions of years have put into practice the modern slogan "Better things for better living through chemistry" for they were gaining a good living through their chemical activities when Wilmington, Delaware, was a steaming carboniferous swamp crawling with dinosaurs.

Although this disintegration of materials, in its grand biological strategy, is advantageous to man, certain aspects of it are distinctly disadvantageous if not downright antagonistic, for the fungi all too successfully compete with man for the materials he has spent time and money in manufacturing and quite naturally wants for his own use. For these organisms it has been an easy transition from the difficult task of extracting food materials from relatively resistant plant parts to securing such nutrient

substances from relatively vulnerable manufactured materials such as the cellulosic fabrics. Similarly, although from the activities of somewhat different sets of fungi, these destructive activities extend to such other manufactured cellulosic materials as wood pulp, paper, wall board, ply wood, and cellulose nitrate films. It is a great credit to the ingenuity and resourcefulness of the chemists of organizations largely represented here that this persistent competition has, in part at least, been successfully restrained.

To the next question, that of the nature and identity of the fungi chiefly responsible for the deterioration of textiles in the Pacific theatres the answer is not yet final. A priori there are two main possibilities (*1*) that the fungi are of the same general type as those causing similar destruction in temperate climates but much more active under the more favorable conditions of the tropics; (*2*) that at least some of these organisms are different in identity, essentially more formidable and destructive in character, their effects accentuated by favorable conditions.

Some information has accumulated from outstanding work in the Pacific theatre by the Australian scientists and from analyses of returned materials by the Canadian Research Council, by our Department of Agriculture, and by other laboratories in this country and elsewhere. Realizing the need for additional fundamental data, the Research and Development Branch of the Office of the Quartermaster General, in its comprehensive program for the study and control of tropical deterioration, has secured from various representative points in the south and southwest Pacific areas numerous sets of samples of deteriorated materials, accompanied by significant reports and other pertinent information. Although work on this material in the Tropical Deterioration Research Laboratory at the Philadelphia Quartermaster Depot is still in its initial stages, preliminary findings have already added significant supplementary information to that previously accumulated.

The evidence now available lends some support to each of the two possible interpretations and, to avoid fatiguing you with technical mycological details, may be summarized briefly as follows: The assumption that the same general array of molds causes deterioration in the tropics as elsewhere is supported by the frequent occurrence among the isolations from tentage and tarpaulins of the Pacific theatre of several of the same genera and even of the same species that are notorious for injury to such materials in this country and England. As might be expected also the familiar superficial molds are common on Pacific tentage as they are on the most diverse materials in almost world wide distribution. Yet on the other hand, the alternate assumption finds support in the presence of some genera and species which are rather unusual, distinctly different from the usual isolates and of fairly common occurrence under conditions indicating they probably play a significant part in the deterioration of the textile samples.

As the tedious and technically difficult task of determining the identity and analyzing the destructive activities of these causal agents responsible for tropical deterioration continues to progress in many laboratories from Philadelphia to Sydney, Australia, the information which accumulates will prove of the greatest practical value. Even now we have ample evidence that in the field of tropical deterioration even of textiles such as tentage we have to contend with a complex, diverse, versatile, and generally formidable array of molds. Some of these are superficial mildews, rapid in development and highly efficient, their great physiological diversity enabling them to obtain their nutriment from the most unlikely and varied materials, hence capable of destroying the waterproofing of the tentage and of reducing the copper content of mildewcides to below the lethal minimum essential for protection. Others are highly efficient destroyers of cellulose, capable, once they have gained access to the fibres through microscopic crevices, of breaking them down rapidly under favorable conditions of moisture, temperature, and availability of accessory nitrogen sources of nutriment. All of them are prolific in multiplying themselves, hardy in endurance, aggressive in activity, well fitted for survival under a wide range of conditions. Although for precise results we study them singly in pure cultures, under natural conditions they occur in multiple mixtures or complex successions of populations, their interactions being intricate and of great biological and practical importance. They may compete among themselves as they do with other organisms (from bacteria to chemists!) and the

subtleties of their antibiotic action we are just beginning to appreciate through the study of such therapeutically valuable antibiotic substances as penicillin. They may collaborate, either successively, one by its activities preparing the way for another, or jointly, accomplishing in combinations what neither component could achieve separately.

In addition to the molds, mildews, and other fungi on deteriorated tentage there are bacteria, of which several types have been found occurring frequently on the samples secured by the Office of the Quartermaster General from the Pacific theatres, the conditions of their occurrence justifying the suspicion that they may participate in the deterioration.

If you are thinking that this general picture is being presented as unduly complicated because the enthusiasm of a technical specialist leads him to revel in the delightfully nauseating aspects of this whole happy nightmare, let me reassure you that there is ample evidence to support my statements, and that problems involving equally complicated situations have been solved in other fields and let me remind you that the enemy should not be underestimated, intimate knowledge of his capabilities being essential to the grand strategy and detailed tactics for his defeat.

The final problems we must consider are those involved in our major objective of control. The approach to the prevention of tropical deterioration has mainly been one of applying promising preventives developed by the chemical industry, using methods of application adapted to the usual machinery and processes of the textile industry. Through this approach notable advances have been made and some of the treatments developed and applied show great potentialities. If they were wholly successful, the problem of the control of tropical deterioration of textiles would now be only of historic interest and would no longer arouse concern. Unprejudiced examination of numerous reports from the Pacific theatre and of samples of tentage in use there only three months, yet severely deteriorated, shows convincingly that the problem still demands attention.

Concerned in the problem are the textiles themselves, the finishes, and other chemical treatments they receive, the action of the living and non-living tropical environment to which they will be subjected. Hence the answers will require the cooperation of textile experts, chemists, mycologists, and bacteriologists. Since these are all represented here and this Association has played an important part in textile research and development, this is a favorable opportunity for considering how the situation may most effectively be met. Since the atmosphere in these meetings fosters open discussion and productive controversy, perhaps it will not be unduly presumptuous if I bring up a few questions as to possible lines of attack on the problem of control.

The most pressing questions are involved in the treatment of cellulose textiles such as tentage for prevention of deterioration. Of the three essentials (*1*) suitable moisture, (*2*) favorable temperature, and (*3*) available food material on which the development of molds depend, it is obviously only the third that offers possibility of control under field conditions in the tropics. Fungous spores, invisible, but ever present in vast numbers, can not be actively driven away by repellents as can destructive insects, and the tentage inevitably will acquire thousands of them. Is it not possible that the present method of treating such textiles defeats its purpose by attempting to do too much in one operation? May not the application of flame-proofing, water-proofing and mildew-proofing agents in one bath with squeeze rollers reduce the efficiency that would be attained if the mildew-proofing were applied first and the other proofings later in a two or even three bath procedure? Marked differences in mildew resistance between one panel of a tent and the next as often observed certainly seem to indicate lack of uniformity of treatment by present methods. Bear in mind that the fungous spores that are continually reaching the tentage will remain there, persistent, and long enduring, ready to penetrate and destroy when the barriers you have applied become inadequate.

The reasons, such as inadequacy of equipment and impractical complication of efficient manufacturing procedure, offered in support of the present method, are adequate in the case of one plant producing a rush order now but not for the whole industry indefinitely in a country that has met greater manufacturing difficulties in producing materials such as synthetic rubber.

The continued effectiveness of mildew-proofing compounds under long exposure involves continuing endurance of the preventive power of these compounds against the destructive power of incessantly reinforced hordes of fungous spores. In general the action of mildew-proofing compounds may be either fungistatic, preventing fungus development, or fungicidal, killing the fungi that come in contact with them, or neutralizing, rendering the fungi impotent by paralyzing or counteracting their enzyme systems. In opposition the action of the fungi is to deplete, counteract, combine with and generally wear down the mildew-proofing and in this they are aided by other living and non-living components of the tropical enivronment. There is need for further knowledge of the biochemical activities of fungi in relation to the protective action of mildew-proofing compounds and various laboratories are working on this difficult problem. There is need also for further research on the methods of mildew-proofing textiles and the laboratories affiliated in this Association have the skill, equipment, and incentive to prosecute this. Is it not possible and even practical to impregnate effective and enduring mildewcides into the yarns themselves rather than onto the completed textile after weaving? May it not be possible and practicable to affix such substances to the cellulose of the cotton fibres in intimate attachment in the manner of substantive dyes? Since cellulose itself is so vulnerable, is it not a practical approach to attempt to render it chemically unavailable to molds yet still retain its desirable qualities for textiles as cellulose acetate is unavailable yet retains the desirable plastic qualities of vulnerable cellulose nitrate?

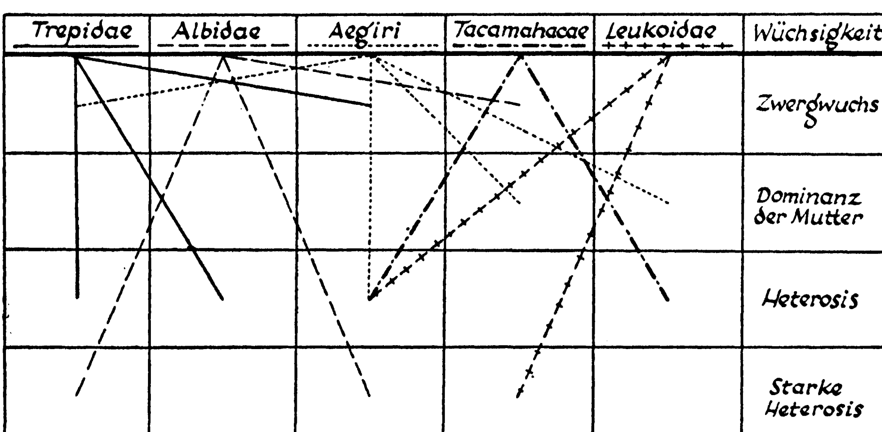
In conclusion, the comprehensive and complicated nature of the important problem of tropical deterioration should again be emphasized. Its many aspects touch most of the interests and activities represented in this Association. Collaborative action towards its solution will be far more effective than the efforts of any one specialized group. The more agencies, industrial, governmental, and institutional, attack its various aspects, the better. The inevitable duplication of effort, viewed with alarm by some is inevitable, since present conditions prevent coordination under one direction and in the long run may well prove advantageous. Although the problem has been accentuated by the exigencies of this war, its importance will continue in the inevitable development of tropical resources which will follow. If, along with the many problems that have been considered at these meetings, this problem of tropical deterioration receives its share of attention from the highly competent, technical groups represented here, it is safe to predict notable progress towards its solution will be reported at our next meeting.

● **Ueber den gegenwärtigen Stand der forstlichen Pflanzenzüchtung—Ein Rückblick und Ausblick** (W. von Wettstein, Erwin-Baur-Institut, Müncheberg i. Mark *in* Allg. Forst- und Jagd Z. 118:128-131, 1943): — Im mitteleuropäischen Raum liegen die ersten Anfänge der Auslese von Bäumen weit zurück und führen in die Klostergärten, wo Obst- und Zierbäume ausgewählt und aufgezogen wurden. Der Einzelbaum des Waldes wurde bis zur Einführung der künstlichen Bestandesgründung wenig beachtet, es sei denn, Handwerker durchsuchten den Wald nach geeigneten Formen für bestimmte Zwecke. Es wurde so unbewusst eine negative Auslese getroffen, die zugunsten der unbrauchbaren Formen ausfiel. Noch heute kann man im Balkan Hunderte von Bäumen angehackt finden, die von Pilzen besiedelt wurden und bei der Suche nach einem gut spaltbaren Stamm angehackt, jedoch dann nicht weiter beachtet wurden. Vor etwa hundert Jahren wurde an Methoden gearbeitet, die eine bessere Bestandsentwicklung ermöglichen sollten. Der Reinbestand und Kahlschlagbetrieb verlangten eine grössere Menge an Saatgut, und bald übernahm der Handel die Aufbringung und Versorgung des Forstwirtes mit Pflanzgut und Samen. Eine Menge von Samen aus entfernten Gegenden kam so in Umlauf. Der bequeme und billige Bezug von Kiefern-, Fichten-, Eichen- und anderen Samen verminderte die Saatgutselbstwerbung des Waldbesitzers immer mehr. Erst eine Reihe von Misserfolgen gab zu Untersuchungen Anlass, die in vielen Fällen das Saatgut verantwortlich machten. Der Schwede Palmcrantz 1855, der Österreicher Gieslar 1887 und mehrere andere Forscher wiesen zuerst auf die Unterschiede zwischen einheimischen und ausländischen Samen hin. Aufbauend auf Versuchsflächen grösseren Ausmasses lieferten Schott 1904 und Kienitz 1911 aufschlussreiches Material. In der

folgenden Zeit wurde die Provenienzfrage in fast allen forstlichen Versuchsanstalten Europas behandelt und durch internationale Probeflächen die ersten Untersuchungen bestätigt und ergänzt. So konnte in Deutschland bereits die Gesetzgebung nützliche Schlussfolgerungen ziehen, aber auch in anderen Ländern eine Lenkung des Saatguthandels erfolgen. Die eigentliche forstliche Pflanzenzüchtung, somit die Auswahl des besten Saatgutspenders aus der für ein bestimmtes Gebiet geeigneten Herkunft, sollte nunmehr auf diese Untersuchungen aufbauen, aber nur zaghaft wurde dieser Weg betreten. Von züchterischen Arbeiten sind aus dem 19. Jahrhundert eigentlich nur die Versuche DE VILMORINS 1862 mit Kiefern und einige Einzelstammprüfungen von GIESLAR bekannt geworden. Die moderne forstliche Pflanzenzüchtung ist naturgemäss erst nach der Wiederentdeckung der MENDEL'schen Vererbungsgesetze 1900 möglich geworden und setzt im zweiten Jahrzehnt unseres Jahrhunderts ein. Männer wie BURGER, BUSSE, DENGLER, FABRICIUS, HENRY, V. LOCHOW, MÜNCH, SYLVÉN, SYRACH LARSEN und STOUT sind mit der Untersuchung über züchterische Massnahmen beschäftigt. Wir müssen aber zwischen Grundlagenforschung für züchterische Massnahmen und praktischer Nutzanwendung der Züchtung unterscheiden. Der Zweck einer Züchtung ist letzten Endes, Pflanzen zu gewinnen, die einen höheren Ertrag und hochwertigere Eigenschaften besitzen als bisher. Die neue Sorte einer Art muss sich von der im Walde wachsenden unterscheiden und möglichst gleichmässige Nachkommenschaften liefern. Die Einführung einer neuen Spezies aus anderen Ländern ist keine Züchtung, sondern die Auslese besserer Typen aus einer Spezies, deren Nachkommenschaften infolge erblicher Anlagen in den folgenden Generationen gleichwertig bleiben. Naturgemäss werden Arten, die vegetative Vermehrung gestatten, rascher Erfolge bringen als Arten mit nur generativer Vermehrbarkeit, und unter diesen werden Selbstbefruchter andere Methoden erfordern als Fremdbefruchter. Erst in den letzten Jahren wurde das Versäumte nachgeholt und statt der unkontrollierten Befruchtung durch die Saatgutanerkennung eine wenigstens teilweise kontrollierte Befruchtung eingeführt. Der grosse Fortschritt, der zur systematischen Züchtung führt, ist nun gemacht, und die gegenwärtigen Arbeiten auf züchterischem Gebiet bauen darauf auf. In den letzten 15 Jahren wurde besonderer Wert auf die Blütenbiologie gelegt und die Kreuzungsmöglichkeit studiert. Wir befinden uns noch in den meisten Fällen in der Vorarbeit der "Grundlagenforschung", und nur in einzelnen Fällen kann die Praxis schon Nutzen ziehen. Es ist geschichtlich interessant, dass FISCHBACH 1838 schon glaubte, selbstfertile Buchen zu kennen, und SYLVÉN 1910 Versuche mit selbstfertilen Fichten in Stockholm machte, deren Auswertung erst 1939 durch LANGLET erfolgte. Über den Erbgang einzelner Eigenschaften hat OPPERMANN für Buchen Beweise geliefert. Der Wert der kontrollierten Befruchtung wird klar durch die Arbeiten DENGLERS, SYRACH LARSENS und W. V. WETTSTEINS. Werden z. B. Kiefern verschiedener Herkunft mit verschiedenen Eigenschaften gekreuzt, so zeigt es sich, dass einzelne Verbindungen bessere Nachkommen ergeben als die Eltern waren oder bedeutend grössere Massenentwicklung besitzen. Die Erfahrungen der Landwirtschaft, dass durch Kreuzung verschiedener Arten, Rassen oder Formen eine Nutzungsgeneration (sog. Nutzungs-$F_1$) erhalten werden kann, sind eindeutig auch für Nadelbäume nachgewiesen worden.

Auf ERWIN BAUR geht folgende Züchtungsmethode zurück: Wird bei einem Fremdbefruchter Auslese vorgenommen, so ist es notwendig, eine Linientrennung vorzunehmen. Das besagt, dass eine Prüfung von Nachkommenschaften einzelner Individuen durchgeführt werden muss, die auf alle Fälle zeigen muss, ob die mütterlichen Eigenschaften dominant oder rezessiv sind. In dieser Richtung haben besonders deutsche Forscher, wie BUSSE, V. LOCHOW und W. SCHMIDT, bahnbrechend gearbeitet. Im allgemeinen sind bei Fremdbefruchtern die dominanten Eigenschaften durch die ständige natürliche Mischung häufiger zu finden, und bei der Auslese nach der Mutter tritt der Einfluss des väterlichen Pollens weniger zutage. Die Prüfung von Einzelabsaaten setzte ein und hat für die Eigenschaft des Jugendwuchses schon einige bemerkenswerte Ergebnisse gebracht. Die forstliche Anerkennung von Waldteilen zur Samengewinnung entspricht etwa der Massenauslese der Landwirtschaft, und die weitere Einengung auf Festlegung einzelner Individuen ist der weitere Schritt zur Einzelauslese. Die weitere Folgerung aus diesen Erkenntnissen ist die künstliche Befruchtung zweier bestimmter Bäume, die gute Nachkommenschaft liefern. Auch hierfür sind mehrere

Methoden ausgearbeitet worden. Ein solcher Weg ist, Bäume zu suchen, welche bei Selbstbefruchtung keine Inzuchtentwickling, sondern normale, gute Nachkommenschaft besitzen. Die meisten unserer Bäume sind aber Fremdbefruchter, doch gibt es, wie für Buche, Eiche, Birke, Ulme, Linde, Tanne und Fichte nachgewiesen ist, auch Einzelbäume, die durch Anwendung künstlicher Mittel zur Selbstbestäubung gebracht werden können. Diese Methode, um wertvolles Saatgut zu erhalten, ist sehr langwierig und wohl dem Zufall überlassen, ob früher oder später ein geeigneter Baum gefunden wird. Eine andere, viel aussichtsreichere Durchführungsart ist die künstliche, auf bestimmte Formen aufgebaute Kreuzung. Zwei Bäume werden als Eltern ausgesucht und stehen jährlich für die gleiche Befruchtung zur Verfügung. Die entstehende Nachkommenschaft ist je nach dem genetischen Verhalten der Eltern gleichförmig, oder sie spaltet in verschiedene Formen auf. Est ist Sache der züchterischen Auslese, hier die notwendige Sichtung vorzunehmen. Kennt man aber zwei günstige Kreuzungspartner, so ist es gerade ein Vorteil gegenüber anderen Pflanzen, dass man durch Jahrzehnte die gleichen Bastarde herstellen kann. Bei *Salix, Populus* and *Ulmus* kann man Blütenzweige ins Gewächshaus stellen, dortselbst künstlich kreuzen und den Samen ernten, oder, wie Syrach Larsen, ganze Bäume einhüllen und mit Hilfe eines Gebläses bestäuben. Werden Bäume aus Standorten, die infolge ihrer geographischen Lage oder aus ungünstigen klimatischen Gründen nicht gleichzeitig blühen, gekreuzt, so hilft die Pfropfung blühfähiger Zweige auf ein- bis dreijährige Bäumchen, um am gleichen Ort die Bestäubung vorzunehmen. So können z. B. Zweige eines Kiefernbaumes aus Sibirien in Leipzig auf zweijährige Pflanzen gepfropft werden, und nach 1-2 Jahren werden die weiblichen Blüten mit Pollen einer Kiefer aus Spanien bestäubt. Diese Möglichkeit haben Syrach Larsen und W. v. Wettstein bereits erproben können. Bei manchen sehr reich fruchtenden Bäumen wird eine teilweise Isolierung genügen, z. B. bei der Birke oder Erle. Es ist dies lediglich eine Organisationsfrage geworden und könnte von der Praxis in dem notwendigen Umfange durchgeführt werden, sobald die Individuen ausgesucht sind, die die gewünschte Leistung sicherstellen.




Von grosser Bedeutung dürften die Bestrebungen sein, auch schwer vegetativ vermehrbare Baumarten ungeschlechtlich zu vermehren. Die Herstellung von Klonen gleicher genetischer Zusammensetzung mit Hilfe von Wuchsstoffen wird vielfach versucht. Auch hier ein Beispiel: Die finnische Maserbirke wird heute in Schweden in grösstem Ausmasse durch Pfropfung und bewurzeltes Steckholz vermehrt, so dass in wenigen Jahren der Markt mit diesem hochwertigen Furnierholz beliefert werden kann.

Ausser der Kreuzung innerhalb einer Art kommt auch die Herstellung von Bastarden zweier Arten in Betracht. Es ist besonders bei solchen Bastarden sehr häufig eine bedeutende Wuchssteigerung zu beobachten. Die schönsten Ergebnisse sind bei *Larix Kämpferi* × *decidua, Picea Engelmanni* × *sitchensis, Alnus cor-*

*data* × *subcordata* und bei *Populus* erzielt worden. Die Untersuchungen über die Kreuzbarkeit verschiedener Pappelarten lieferten wertvolle Grundlagen für die Züchtung, und es wäre wünschenswert, ähnliche Übersichten für andere Gattungen festzulegen (s. Abb.) Von grösstem Interesse wäre es auch, durch zytologische Untersuchungen die Anzahl der Chromosomen unserer Bäume, und besonders der Bastarde, festzustellen. Wir können heute auf Grund von Wurzelspitzenuntersuchungen ohne Schwierigkeiten Sand- und Moorbirke und deren Bastarde unterscheiden. Erstere besitzt 2 n = 28 Chromosomen, letztere 4 n = 56 Chromosomen und die Bastarde 3 n = 42 oder mehr je nach der Art der Mutter. In Schweden wurden 7 Espenbäume gefunden, die 56 Chromosomen statt der allgemeinen 28 Chromosomen besitzen. Auch Syrach Larsen hat bei seinen Lärchenbastarden eine Pflanze mit der dreifachen Zahl dieser Erbträger gefunden. Es ist sehr häufig, dass solche Pflanzen eine grössere Wüchsigkeit besitzen, und dies ist auszunutzen. Die Züchtung muss daher bestrebt sein, in grossem Umfange Polyploide (mehrchromosomige Formen) künstlich zu erzeugen, um auf diese Weise *a*) eine Wuchssteigerung zu erzielen, *b*) grösste Mengen an Ausgangsmaterial zu erhalten und *c*) durch Vermehrung der guten Eigenschaften eine grössere Gleichmässigkeit des Pflanzgutes zu sichern. Die forstliche Pflanzenzüchtung hat in den letzten Jahren erhebliche Fortschritte gemacht und in der Grundlagenforschung der Vorsprung anderer Disziplinen fast eingeholt. Die Arbeit mit mehrjährigen Kulturen, deren Nutzung nicht die Frucht, sondern das Holz ist, kann jedoch nicht so rasch den Vorsprung einholen, den die Züchtung annueller landwirtschaftlicher Kulturpflanzen besitzt. Der Forstwirt kann nicht eine verfehlte Kulturmassnahme durch Umpflügen in einem Jahre wieder gutmachen, sondern er benötigt andere Zeitspannen. Es soll aber unsere Forstwirtschaft die neuen Wege, die die Züchtungsforschung gewiesen hat, kennen und die Möglichkeiten, die sich für eine Verbesserung unserer Wälder bieten, aufnehmen. Die Grundlagenforschung für züchterische Massnahmen ist aber in keinem Falle Selbstzweck, sondern muss in engster Fühlung mit dem Walde stehen. Die beste Züchtung kommt nicht zur Wirkung, wenn nicht auch Kulturmassnahmen verändert und erprobt werden oder die Biologie des Waldes in ihrer Gesamtheit einseitig gestört wird. Es soll hier nicht auf die näheren Einzelheiten züchterischer Massnahmen eingegangen, sondern nur der Weg gezeigt werden, der auf dem Gebiete der Züchtungen für die Forstwirtschaft möglich ist. Aus der heute gebräuchlichen Massenauslese entwickelt sich langsam die Einzelauslese. Diese sichert Ausgangsmaterial für Bastardierung zum Zwecke der Erzeugung frohwüchsiger Nutzungsgenerationen. Besonders wertvolle Individuen können durch vegetative Vermehrung gesichert werden. So wird die Züchtungsforschung dazu beitragen, aus den Forstpflanzen für uns das Beste herauszuholen.

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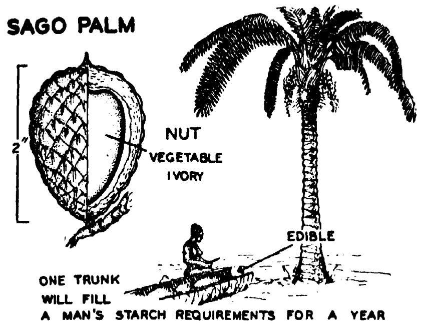
● **Emergency Food Manuals** (E. D. Merrill, Administrator of Botanical Collections, Harvard University *in* Arnoldia 4, 7:29-36, 1944)*: — As everybody at all familiar with world events realizes the present global war is in many respects very different from the first World War. Not only are many operations prosecuted along lines totally different from those which characterized the period between 1914 and 1918, but sources of special information have been developed in a wide variety of fields. Relatively speaking, the last great war was a world war in name, but in the present conflict actual combat involves not only the oceans of the world, but also the continents of Europe, Asia, Africa and the islands of the Pacific. In this second conflict botanists trained and experienced in widely diversified fields are contributing materially to the solution of various complex problems. The emergency food manuals are a small but distinctly important contribution from the fields of systematic and economic botany.

In the early part of the century when I commenced botanical work in the Philippines I soon realized, from field experience, that it was incumbent upon me to accumulate as much knowledge as possible regarding the edible qualities of various jungle plants. In my first year I had the experience of having been marooned for more than a week with no other available food than rice; and boiled rice three times a day with nothing to diversify it, is not only monotonous but is also distinctly not a satisfying diet from any angle. At that time I knew practically nothing about what one could find to eat in the vast tropical forests of the Philippines. Little did I realize that forty years later my services would be drafted to compile the data regarding jungle foods for the benefit of the men in our various services who were called upon to operate in the islands of the Pacific. Several years after the boiled rice experience when three of us were marooned by heavy rains in central Mindoro, entirely out of food and no avenue of escape open to us as long as the rain continued, one of my companions observed, when on Thanksgiving Day 1906 we dined on two broiled wood rats each, supplemented by boiled fern tips, "Cheer up, you couldn't buy a meal like this at Delmonico's." This is, however, no place to enlarge upon the subject of what I have eaten and why, for the list would indeed be a strange one.

It is clear to anyone familiar with the tropics, and who has even a limited knowledge of the plants, parts of some of which may be eaten with entire safety, that there is no need of anyone starving to death in the midst of relative plenty. True, an army could not possibly subsist on what might be found in the jungles, but individuals and small groups of men can find much that may be eaten provided they know what to select. Dr. H. Lam mentions in his most interesting account of his trip up the Mamberamo River to the summit of the Central Snow Range (Mount Wilhelmina) in 1920 that his party met at the Meervlakte two Chinese bird hunters accompanied by nineteen native Papuans, who had travelled inland from the coast to the Idenburg River and thence down the Mamberamo. For a period of seventy days they had subsisted wholly on such plant and animal food as they could secure in the New Guinea forests, proof, if proof be needed, that it is possible to live on the country even in uninhabitated areas such as this one in New Guinea.

Naturally, widely scattered and very rare or local species should not be considered in any popular booklet on edible plants, hence a prime necessity, if anything really useful is to be prepared, is a wide field experience on the part of the compiler. He must in the first place know the tropics from personal experience, and in the second place he must know what plants and plant parts may be eaten, either crude or processed

* Since this article was published several new manuals have been published, some of them of dubious value. Outstanding—according to Dr. Merrill—is the U. S. Navy's "How to Survive on Land and Sea" (*see* plate 12).




**Range:** Throughout, except Polynesia; mainly in shore swamps, but also up to 1,500ft.

**Habit:** A tree 30ft. to 60ft. high, shorter and bulkier than Coconut; the leaves spiny, with midribs thicker than bamboo. A flowering trunk, packed with starch, shoots up when the palm is 10 to 20 years old; the palm dies after this. The large nut yields vegetable ivory. Several palms seem equally good for sago.

**What to Eat;** These palms support large populations, *e.g.*, New Guinea and Ceram. One trunk, cut when flowers are due, will yield 600lb. of sago (enough for a man for one year) in return for a few days' hard work. Method: Cut away bark of upper side of trunk and pound up the soft, whitish inner parts with a club, perhaps with a bit of

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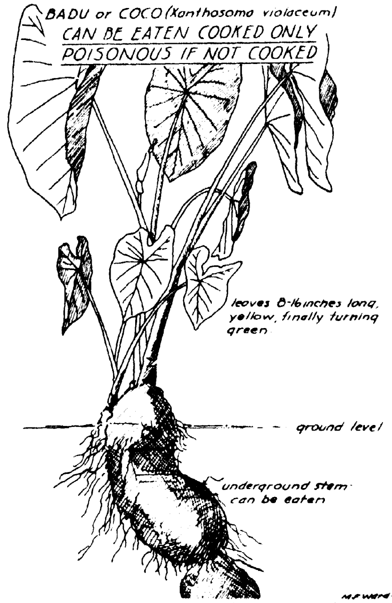


BADU IS GROWN IN THE CANAL ZONE FOR ITS POTATO-LIKE ROOTS, WHICH ARE COOKED AND EATEN LIKE POTATOES. THE PLANT HAS ALSO RUN WILD IN SOME PLACES. BOTH THE ROOTS AND LEAVES OF THE BADU CONTAIN CALCIUM OXALATE CRYSTALS WHICH ARE DESTROYED BY COOKING. SEVERE IRRITATION OF THE MOUTH AND THROAT IS CAUSED BY EATING THE UNCOOKED TUBERS.

PAGE 19

22 QUARTERMASTER CORPS

*k. Sweet sop* (*Annona squamosa*).—This is a small tree, usually 15 feet high, and is found both wild and in cultivation. The medium-sized pale green fruit is of excellent

FIGURE 71.—Sweet sop (*Annona squamosa*).

flavor and is always eaten raw. This tree is found chiefly in and near settlements, not in the forests. Local names: *Átis, atist, apéli, áta, sarikája, srikája, sirikája, srikáwis, sarkádja, garóso, pérse, hirikája.*

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46. PANAMA TREE

*Sterculia apetala*

The fruit of the Panama tree is formed like a large flower consisting of five large pods, each containing several seeds resembling chestnuts. These seeds may be eaten either raw or roasted. *CAUTION: The inside of the pods is covered with stiff bristles that penetrate the skin easily and cause intense irritation.* The tree is very large and is common in the lowland forests of the Caribbean region. Its leaves are light green and fuzzy on the underside, its fruits are brownish green. In Panama the tree is known as *panamá;* in Central America *castaño;* in Cuba *anacagüita* and *camaruca;* and in Colombia *camajón.*

PLATE 12.—Representative pages from four of the booklets discussed by Dr. MERRILL (pp. 174-76).—*Top, left:* from "Food is where you find it, a guide to emergency foods of the Western Pacific, 1943", published by the Auckland Institute and Museum, New Zealand.—*Top, right:* from GODSHALL's "Edible, Poisonous and Medicinal Fruits of Central America, 1942", published by the Panama Canal authorities.—*Bottom, left:* from Dr. MERRILL's "Emergency Food Plants and Poisonous Plants of the Islands of the Pacific, 1943", with drawings by GORDON W. DILLON, published by the Supt. of Documents, Washington, D. C.—*Bottom right:* from DAHLGREN and STANDLEY's "Edible and Poisonous Plants of the Caribbean Region, 1944", published by the Supt. of Documents, Washington, D. C.

Fig. 38. Climbing Coconut Palm

Fig. 39. Shinnying

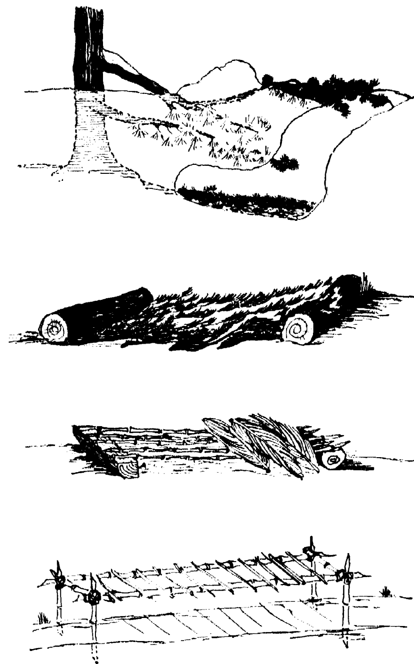

Fig. 40. Right Way

Fig. 41. Wrong Way



***Fixed Snares***

Fixed snares are fastened to stationary objects such as logs, trees or a forked stake. (See Figure 139.) To be most effective the snare should be set near a bush or limb where the animal will get tangled and strangle itself while struggling. This is particularly useful for catching rabbits and hare.

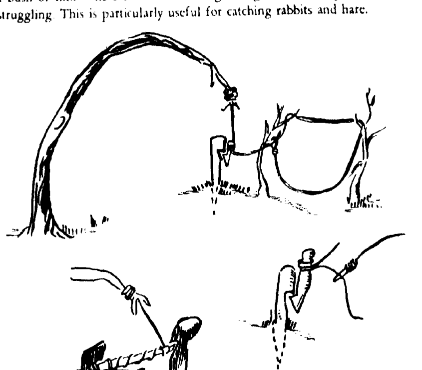

Fig. 143. Hanging Snares Set on Trail. Closeup of Triggers

In the jungle, small mammals and especially birds such as pheasants and jungle fowl are more readily snared by building a low fence of sticks on either side of the runway to lead them to the trap. The treadle spring snare is very effective for such a set. A spear trap should be used for large mammals. (See Figures 145 and 146.)

***Deadfalls***

Deadfalls will trap both birds and mammals and the basic principles can



but should preferably be boiled to a gelatinous mass. The buds of basswood, poplar, maple, the shoots of spruce, tamarack and the inner bark of willow, alder, hemlock, basswood and birch are all edible. The leaves of mountain sorrel, young willows and fireweed can be eaten when boiled.

Fig. 264. Iceland Moss (*Cetraria islandica*)

Fig. 265. Reindeer Moss (*Cladonia rangiferina*)

Fig. 265a. Rock Tripe (*Umbilicaria*)

***Lichens***

*The most widespread and surest source of emergency food in the far north are the lichens, some of which are mosslike in appearance.* Often these small plants cover large areas, growing on rocks, trees, logs and in sand and gravel. They sometimes grow where there appears to be no soil. The lichens are gray, brown, or black in color and are rich in carbohydrates, furnishing food for many northern mammals. Some are eaten by Eskimos and European peasants during famine periods. None are poisonous, but some contain a bitter acid that causes internal irritation unless they are cooked in water, dried until brittle, and then powdered and boiled.

Plate 13. — Four pages from the excellent and reliable guide for individual survival training, "How to Survive on Land and Sea . . .", prepared by the United States Navy and published by the U. S. Naval Institute, Annapolis, Md.

— and some plant parts must be processed before they can be eaten in order to eliminate certain poisonous principles. But what is of even greater importance than this is a knowledge of what are the common and widely distributed species. It would be utterly valueless were a species to be included that is so rare or so local that no one could possibly expect to find enough to satisfy, in part, the hunger of even one man.

The first emergency booklet prepared was a small one compiled by Captain A. B. GODSHALL and published in Panama in 1942, entitled "Edible, Poisonous and Medicinal Fruits of Central America," illustrated by 42 excellent line drawings. Immediately the idea appealed to others and within a very short time after this booklet appeared no less than twenty-one different individuals or agencies, representing various branches of the service, commenced to play with the idea of preparing something for the benefit of our service men who might become separated from their commands and who might have to live for a time on what they could find in the tropical jungles. There was no coordination of these endeavors, and too frequently individuals with no knowledge of the subject and with no tropical experience were assigned to the task of compiling data. Because of this confusion a meeting of representatives of the various services was arranged under the auspices of the National Research Council in Washington in September, 1942. The result of this conference was to enlist my services to prepare the copy for a booklet appertaining to the Pacific islands, while to Mr. PAUL C. STANDLEY and Dr. B. E. DAHLGREN of the Field Museum of Natural History, Chicago, were assigned the arctic and subarctic regions (including Alaska) and tropical America.

Immediately on my return to Boston from this conference I commenced to compile the data that were available to me, and the result was the completion of the copy and the illustrations late in December, 1942. The booklet of 149 pages with 113 illustrations was issued in a large edition on April 15, 1943. This is Technical Manual 10-420, entitled "Emergency Food Plants and Poisonous Plants of the Islands of the Pacific," issued by the War Department for wide distribution to service men.* It is non-technical, without descriptions, the illustrations taking the place of descriptions, and includes the majority of the common and widely distributed jungle plants that may be used as food, even including some that, unless the seeds or the tubers are properly processed, are actually poisonous if eaten raw. It covers in general certain natural groups such as the palms, ferns, grasses and aroids, followed by a consideration of those species in various unrelated families that produce edible tubers, those plants parts of which may be freely eaten as greens, edible fruits, edible seeds, a brief consideration of poisonous plants that it is desirable to avoid, and finally a consideration of the more common species parts of which, when macerated and thrown into pools or slow streams, will suffocate or poison fish. The area covered is all of the islands of the tropical Pacific, Papuasia, the Philippines, and all of the Malay Archipelago; and for all practical purposes it also covers British Malaya, Indo-China, Siam, Burma, and southern and eastern India. All in all some 128 different edible plants or plant parts are illustrated and others are discussed or mentioned. Some of these species will be found on every island of the entire tropical Pacific region that is high enough to support any vegetation.

A more finished product in this field is the "Edible and Poisonous Plants of the Caribbean Region" by B. E. DAHLGREN and PAUL C. STANDLEY of the Chicago Museum of Natural History, in somewhat larger format than TM 10-420, mentioned above. This is a booklet of 102 pages with 72 illustrations, published by the Bureau of Medicine and Surgery of the Navy Department in 1944, and the equally authoritative "Edible Plants of the Arctic Region" by PAUL C. STANDLEY, a booklet of 49 pages with 27 illustrations, issued in 1943. The former is available to the public through the Superintendent of Documents, Government Printing Office, Washington, D. C., at 20 cents per copy. These, then, are some of the contributions of American botanists who are familiar with their fields and also, on the basis of extensive field work, familiar with the tropics. Little can be said in favor of the botanical parts of "Jungle Desert Arctic Emergencies" and "Jungle and Desert Emergencies" issued under the auspices

* This is available to anyone interested in securing a copy through the Superintendent of Documents, Government Printing Office, Washington, D. C., the price being fifteen cents *in coin* (not stamps) per copy.

of the Army Air Forces in 1944, for the simple reason that too much of the relatively small amount of data about plants included in them verges on botanical misinformation, rather than on real facts.

But the United States Government is not the only one that has tapped this special botanical reservoir of information for the benefit of its service men operating in strange lands. About the middle of 1943 there was issued in Australia a booklet entitled "Friendly Fruits and Vegetables" compiled for the use of Australian service men operating in the Southwest Pacific area. This consists of 71 pages with 37 figures. In August, 1943, there was issued under the auspices of the Auckland Institute and Museum, Auckland, New Zealand, "Food is Where You Find It. A Guide to Emergency Foods of the Western Pacific." This is a 72 page booklet with illustrations of nearly fifty plant species as well as pictures of certain fishes that are poisonous if eaten, and others that inflict severe wounds (including also the poisonous sea snakes and cone shells), as well as other fishes and marine forms that may be eaten with safety. These two antipodean contributions include much the same plant species as those discussed in Technical Manual 10-420. To be mentioned in this category are two booklets issued in Honolulu for the needs of our service men in the Pacific area, one by K. P. Emory, published by the Bishop Museum entitled "South Sea Lore," and one compiled and published by the United States Army, entitled "Castaway's Baedeker to the South Seas." Both of these contain some information regarding edible and otherwise useful Polynesian plants. The former is a booklet of 75 pages and the latter one of 63 pages, and both are illustrated.

Nearer home, and a mine of information regarding the edible qualities of our own species is the Fernald-Kinsey "Edible Wild Plants of Eastern North America," pp. i-xvi. 1-452, fig. 1-129. pl. 1-25. 1943. This was prepared at the Gray Herbarium of Harvard University, and is by far the most complete and most authoritative treatment of our native edible plants that has been issued. It covers the area from the Maritime Provinces to Minnesota southward to eastern Oklahoma and northern Florida. It is available from the Idlewild Press, Cornwall-on-Hudson, N. Y., price $3.00. (See Arnoldia, 4: 8. 1944.)

The published information regarding potential jungle food plants is tremendously scattered in periodical literature, covering the fields of botany, horticulture and agriculture, as well as in various standard botanical treatises. Several of the particularly valuable reference works in the field of economic plants appertaining especially to the Malayan region and hence also to Polynesia, Micronesia, the entire Southwestern Pacific region and all of southern Asia are: Ochse, J. J. & Bakhuizen van den Brink, R. C. "Fruits and Fruticulture in the Dutch East Indies" i-x. 1-180, pl. 1-57 (in color). 1931 (this is an English edition of their "Vruchten en vruchtenteelt in Nederlandsch-Oost-Indië); their "Vegetables of the Dutch East Indies (Edible Tubers, Bulbs, Rhizomes, and Spices Included). Survey of the Indigenous and Foreign Plants Serving as Pot-herbs and Side Dishes." 1-xxxvi. 1-1006, illus. 1931 (this is an English edition of their "Indische Groenten"); Heyne, K. K. "De nuttige planten van Nederlandsch-Indië . . . " 1:1-250, i-xxviii. 1916 (re-issue 1-570, i-lxxx. 1922), 2:1-349, i-xxxix. 1916, 3: 1-402, l-xlviii. 1917, 4: 1-254, i-xxxvi. 1917, d. 2, 1 vol. in 3, pp. 1-1662. i-ccxli. 1927; and Burkill, I. H. "Dictionary of the Economic Products of the Malay Peninsula," 2 vols. pp. i-xi. 1-2402, 1935.

Thus certain information, not previously available in any single volume, some of it based on actual experience and observation on the part of individual authors, some compiled from widely scattered publications, has been assembled. In the compact form of the booklets briefly discussed above, these data have now been made widely available for all who may be interested in acquiring information which, on occasion, may be vitally important. This of course applies especially to individuals lost in the jungles of the tropics, cut off from their food supply and thus those whose lives are dependent on their own efforts.

● **Declaration of the United Nations Food Conference** (*adopted by 44 United Nations and Associated Nations at the United Nations Conference on Food and Agriculture, Hot Springs, Virginia, June 3, 1943. The Conference recommended the establishment of a permanent international organization in the field of food and*

*agriculture, and set up an Interim Commission to formulate plans for permanent organization)*: —

"This Conference, meeting in the midst of the greatest war ever waged, and in full confidence of victory, has considered the world problems of food and agriculture and declares its belief that the goal of freedom from want of food, suitable and adequate for the health and strength of all peoples, can be achieved.

"The first task is to complete the winning of the war and to deliver millions of people from tyranny and from hunger. During the period of critical shortage in the aftermath of war, freedom from hunger can be achieved only by urgent and concerted efforts to economize consumption, to increase supplies and distribute them to the best advantage.

"*2.* Thereafter we must equally concert our efforts to win and maintain freedom from fear and freedom from want. The one cannot be achieved without the other.

"*3.* There has never been enough food for the health of all people. This is justified neither by ignorance nor by the harshness of nature. Production of food must be greatly expanded; we now have knowledge of the means by which this can be done. It requires imagination and firm will on the part of each government and people to make use of that knowledge.

"*4.* The first cause of hunger and malnutrition is poverty. It is useless to produce more food unless men and nations provide the markets to absorb it. There must be an expansion of the whole world economy to provide the purchasing power sufficient to maintain an adequate diet for all. With full employment in all countries, enlarged industrial production, the absence of exploitation, an increasing flow of trade within and between countries, an orderly management of domestic and international investment and currencies, and sustained internal and international economic equilibrium, the food which is produced can be made available to all people.

"*5.* The primary responsibility lies with each nation for seeing that its own people have the food needed for life and health; steps to this end are for national determination. But each nation can fully achieve its goal only if all work together.

"*6.* We commend to our respective governments and authorities the study and adoption of the findings and recommendations of this Conference and urge the early concerted discussion of the related problems falling outside the scope of this Conference.

"*7.* The first steps toward freedom from want of food must not await the final solution of all other problems. Each advance made in one field will strengthen and quicken advance in all others. Work already begun must be continued. Once the war has been won decisive steps can be taken. We must make ready now."

## CURTIS'S FLORA LONDINENSIS*

— AT OUR FRONTISPIECE (PLATE 9) —

*When my eyes are fairly weary of this London of today*
*I withdraw five battered folios all marbled black and grey*
*From their station on my bookshelves and I read the world away*
*In the company of Curtis, prince of botanists, whose word*
*Was the last on London's flora in the reign of George the Third,*
*When he lived at Lambeth Marshes . . . Yes, I know it sounds absurd,*
*But the flowers and Curtis flourished there, the Thames was bright with sedge*
*Not a crumbled wall at Putney but had stone crop on its ledge;*
*There was travellers' joy at Lewisham along the turnpike hedge.*
*Then toadflax throve on Temple walls and lilies slipped their sheath*
*In Lord Mansfield's little pinewood on the way to Hampstead Heath*
*And the copses out at Croydon had white violets beneath.*
*Not a day went by for Curtis without some botanic thrill,*
*He found teasels down at Deptford and 'on Moulsey-Hurst' a squill,*
*And he plucked a twayblade orchis from the turf at Shooters' Hill.*
*For him the Chelsea kingcups blew, for him the mushrooms stood*
*In the pasture-lands of Islington this side of Hornsey Wood;*
*You can't pluck cress on Hounslow Heath, of course, but Curtis could.*
*At times 'Within-sides of old Wells' he found a harts-tongue fern,*
*And every year at Battersea he watched the brief return*
*Of the poppies whose 'fugacity' aroused his quaint concern.*
*And now his London too is fled, there's scarce a petal's trace*
*Of the Thames-side flower that flourished in his Georgian year of grace,*
*Only weed on weed of brick-work that has over-run its place.*
*Yet if you can harbour Curtis (and the elbow-room he claims*
*Speaks itself of ampler ages) take him down and read the names*
*Of his blossoms and their habitats, until your fancy flames*
*With gable-ends and gravel-pits and lanes that gain the down,*
*And rushy streamlets close at hand and sylvan hills to crown,*
*A city almost suburbless, a country-girdled town.*

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* *Poëmatia Botanica, No. 2* (*continued from* CHRON. 7:333). — Reproduced by kind permission from *Punch* July 23, 1924, No. 4333. — Published anonymously, written by HELEN PARRY EDEN. — Suggestions for possible future *Poëmatia Botanica*, or original contributions to this series, will be much appreciated.

## On An Early 19th Century Emergency Food Manual*

*De l'écorce du vert sapin*
*Il voudrait bien nous faire vivre!*
*Il veut accaparer le vin*
*En prétendant qu'il nous enivre,*
*Nous enlever le gout du pain,*
*Nous abreuver de jus d'érables,*
*Nous nourrir de sarments! Gredin!*
*Tu nous traites en misérables.*

## The Shattered Dream of a Cornbreeder†

*Selfed a hundred corn plants,*
*Put each in a cross;*
*Selfing without testing,*
*Means a heavy loss.*

*Looked around the country,*
*Found a fertile field,*
*Used a ten-ten lattice*
*To find out how they'd yield.*

*Analyzed the variance,*
*Wanted just the best;*
*Planted only thirty,*
*Threw away the rest.*

*Thirty, good in hybrids,*
*That would be a plenty;*
*Heavy rains, and lodging;*
*Then there were twenty.*

*Still had twenty inbreds*
*Looking mighty keen;*
*Hot, humid weather;*
*Smut left thirteen.*

*Lucky thirteen inbreds,*
*Glad to be alive;*
*Wilt, blight, and aphids;*
*Then there were five.*

*So passed the summer,*
*Full of sweat and tears;*
*Came then the harvest—*
*Four had rotted ears.*

*One sturdy inbred,*
*All, all alone;*
*It has no sex appeal,*
*Can't find a home.*

FREDERICK D. RICHEY

* *Poëmatia Botanica, No. 3.* — It is generally assumed that the above song, popular during the French revolution, refers to VILLARS' Catalogue des Substances Végétales qui peuvent servir à la nourriture de l'homme . . . (Grenoble, ca. 1794). *Cf.* A. CHABERT 1897, VILLARS sous la Terreur (Bull. Herb. Boissier 5:821).

† *Poëmatia Botanica, No. 4.* — Reprinted, with kind permission, from the *Journal of the American Society of Agronomy* ("Joint contribution from the Bureau of Plant Industry, Soils, and Agric. Eng. of the Research Administration, U. S. Dept. of Agriculture, and the Tenn. Agr. Exp. Station, Knoxville, Tenn. Read before a meeting of the Crops Section, Am. Society of Agronomy, Cincinnati, Ohio, Nov. 12, 1943.")

# INTERNATIONAL RELATIONS

**The International Institute of Agriculture in Rome:** — A wireless to *The New York Times* states that, according to Prof. UGO PAPI, gen. secretary, all property, including the archives of the Institute, is safe. The occupying authorities did not deprive the institute of its diplomatic immunity, enjoyed since its founding in 1905. During the occupation the institute was allowed to continue as in peace time and representatives of principal nations at war against the occupying countries went on with their research unmolested. Since the Allied entry into Rome such of the institute's personnel as belong to non-allied nations likewise have been respected. — We will bring a list of recent publications of the Institute and some notes concerning its present staff in the next volume of the CHRONICA.

**A Conference on Problems of Restoring International Scientific and Scholarly Coöperation,** organized by the National Research Council of the U.S.A. was held in Washington, D. C., on December 13, 1944. — The problems discussed included: *1)* International exchange of national scientific literature and journals (SHAPLEY, LYDENBERG); *2)* Resumption of publication of international scientific transactions (FLEMING, VERDOORN); *3)* Report on plans for restoration of libraries and participation therein of scientific and scholarly organizations (EVANS, MILAM, SCHAEFFER); *4)* Resumption of international activities: Correspondence, meetings, congresses, coöperative undertakings (FIELD, KELCHNER); *5)* Means of obtaining information regarding needs of scientific workers (ARNASON); *6)* Exchange of scientific personnel (MOE, GALPIN, WEAVER); *7)* Possible services of industrial and institutional laboratories (JEWETT, COMPTON); *8)* Relation of present international scientific organizations to such a United Nations organization as may be created; *9)* An international center for intellectual relations (LELAND); *10)* Interest of the Department of State, Division of Cultural Coöperation (HOVDE, KELCHNER, THOMSON).

The Division of Foreign Relations of the National Research Council has conducted extensive enquiries, during the past months, on the activities and future plans of international scientific organizations, 1919-1944. A mimeographed report, chiefly prepared by Dr. R. M. FIELD has been issued. This most intriguing and stimulating paper is being revised and condensed at present by Drs. W. B. CANNON and R. M. FIELD and will be published in the course of 1945 in CHRONICA BOTANICA.

**Significance of International Collaboration in Forestry and Forest Products:** — At a meeting of the Washington Section of the *Society of American Foresters,* Aug. 1, 1944, at which he was awarded the *Sir William Schlich Memorial Medal,* Dean Emeritus HENRY S. GRAVES of the Yale School of Forestry spoke on the international aspects of forestry. This address, more or less a report of the Panel Subcommittee on Forestry and Forest Products of the United Nations Interim Commission on Food and Agriculture, is of such a broad interest that we are bringing it in full, with kind permission of the author and the editors of the (American) *Journal of Forestry.*

"The inclusion of forestry in the scope of international cooperation in food and agriculture recognizes that forests represent one of the world's great renewable resources, intimately related to agriculture and of great significance in the broad objective of betterment of standards of living of peoples in all countries.

"*Comprehensiveness of Project.* — Achievement of this objective can be secured only by more effective production of forests through application of forestry and through intensive utilization and widespread distribution of forest products to consumers. The purpose is to capitalize the results of research and experience in forest production and wood utilization, together with effective engineering and efficient industrial organization, to obtain from forests their largest economic, social, and industrial services. This is the most comprehensive project so far undertaken in forestry, which constantly and consistently maintains in balance both forest production and utilization in all their aspects. It means that in problems of utilization continued production through forestry practice is kept in mind. This is true in considering problems of opening up virgin supplies of timber in the tropics and elsewhere, in interpretation of problems in regions where forests are overcut or otherwise injured by circumstances of the war or previously, and in appraising the capacity of forest regions to supply postwar needs of the world for forest products. It is ever clearer to me that the world's needs for forests and forest products must be met through skilled

forest production in contrast to reliance on exploitation of virgin and other forests produced by nature without efforts by man.

"It is commonly said that we are entering a 'new era of wood,' reflecting the values flowing from research in wood technology that is providing many new uses of wood of great prospective service in industry and the arts. These developments in wood utilization will have profound influence on silvicultural practice and they emphasize the need and increased possibilities of raising the level of forest production.

"The idea of international collaboration in forestry and in utilization and distribution of forest products is not new. You are familiar with the activities of the International Union of Forest Research Institutes; the International Institute of Agriculture at Rome; the C.I.B. (*Comité International du Bois*), built up and vigorously conducted by Mr. GLESINGER; and the C.I.S. (International Center of Silviculture) at Berlin. Of special significance are the Imperial Forestry Institute and Imperial Forestry Bureau at Oxford, presided over by Professor H. G. CHAMPION, a member of the Subcommittee on Forestry and Forest Products.

"These and various trade organizations indicate that already the need of international cooperation in forest problems has been recognized. The present effort of the Interim Commission is more comprehensive in scope. It is not designed to exclude other agencies in the international field, but it may in the long run incorporate the activities of the I.I.A. at Rome, C.I.S. at Berlin, and C.I.B., each of which has its own legal foundation.

"*A Center of Information.* — As I see it, the proposed new agency will have great significance to us in this country as well as to other countries. First of all, it will serve as a center of information regarding the forest resources of all countries, and their present and potential service from a national and world standpoint. This will include facts regarding the extent, distribution, character, and condition of forests in each country; the distinctive place of forests in national economy; present utilization of forests for home consumption and for exports; imports and consumers' needs for forest products not now supplied; present and potential capacity for forest production; extent of application of forest conservation; public policies with reference to forest ownership; extent of public ownership and problems of administration; public controls of cutting on private lands; public education in forestry; progress of research in all aspects of forestry and forest utilization; technical forest education; effects on forests of war cuttings and of destruction in battle zones; character and organization of forest industries; and other problems of securing the highest services of forest resources.

"The foregoing represents the type of information that would be assembled and kept up to date for the benefit of all nations. Naturally provision would be made for dissemination of information through appropriate publications and a competent inquiry service. The present Subcommittee on Forestry and Forest Products has initiated the assembling of information of this character, not only for use in its reports to the Interim Commission but also as a foundation for the work of the permanent organization.

"*An Instrument for Service.* — The objective of the proposed agency reaches beyond the establishment of a clearing house of information, statistical, descriptive, and interpretative. Practical results depend on the character of the organization and on its personnel. Bearing in mind that its functions beyond those above described are advisory rather than administrative, we believe that if properly constituted it can be made definitely a dynamic instrument of enlarged service in forwarding every phase of forest conservation and utilization. We are thinking in terms of an organization of able and distinguished experts in the several fields of forestry competent to interpret basic data and problems and to provide effective advice where desired. There would doubtless be provided in different countries liaison services representing the central agency. Existing local organizations, scientific, economic, and industrial, would be fully utilized in cooperative undertakings, and it is my hope that higher officers of the central agency would personally visit different countries, for their own education and for such personal contribution as would inevitably result from personal contacts with national leaders in forestry.

"I have been greatly impressed by the benefits I myself have received from distinguished foresters from other countries who have visited the United States. I dare say that Dr. HESSELMAN's visit to the United States many years ago was a large factor in stimulating research and education in forest soils. He did not come to advise but to study our conditions. His influence was far-reaching. Doubtless the central international agency could render material service in facilitating visits by foresters to countries other than their own.

"Again some of the less developed countries which have not yet established policies in forestry would find a competent and impartial organization to aid in their first efforts, whether in inauguration of a forest service, development of research and technical education in forestry, organization of forest surveys, or other undertakings.

Naturally the agency would be prepared to arrange for international meetings, of general or specialized character.

"It is natural that individual foresters in various fields of forestry and forest utilization will inquire how such an international organization as I have described will be of aid in meeting their special problems, particularly if its headquarters are located in some other country. Direct value is obvious for those who are interested and able to follow the literature or are in a position to meet representatives of the agency. Certainly the statistical service providing information regarding production and distribution of forest products will be of immense value to the industries; and every public forest agency facing problems of policy and administration would be aided by knowing how other countries are endeavoring to meet analogous situations.

"*American Forest Resources.* — I cannot overemphasize the importance of the proposed international enterprise in projecting plans for development and use of our own forest resources, not only in meeting immediate post-war problems but during the years to follow. We still have a large aggregate volume of timber available for our own needs and for export. We have extensive cut-over lands, now badly depleted, but capable of greatly increased production if properly handled. Our forests are composed of diversified species of utility including fast-growing conifers. When one studies the forest resources of the world from the standpoint of their present and potential contribution in local, national, and world economy, the United States has an important part to play. We have highly developed forest industries and transportation facilities. The descriptive and statistical information regarding the current production and distribution of forests in other countries, consumer needs, and capacity for sustained production in other countries, will be of great significance to industry and in planning for applied conservation of our forests.

"It is from this standpoint that we should appraise the problems of management of our timber resource. This applies both to virgin timber supplies, public and private, and to the older age groups in second growth. It calls for intensive utilization with least possible waste in logging and manufacture. It calls for planned effort to maintain regionally a continued source of older second growth.

"When one reviews the situation in this country and the trends downward, not only in removal of virgin supplies but in overcutting of second growth, and the small production in contrast to what should be fully feasible, the conclusions are very sobering.

"Personally I find the study of forest activities of other countries of value in appraising and interpreting our own national problems. It is helpful in formulating objectives and standards of what may be attained under our special conditions. By what standard shall we measure the possible services of forests in this country both in our own national economy and in contributing to an expanding world economy? I would set the standard of ultimate achievement very high. I believe that there is opportunity to make the United States one of the leading nations in all aspects of forestry. I base this judgment on our extraordinary natural endowment of forests and their potential service, on my belief in the basic intelligence, ability, and ingenuity of our peoples, on the economic, financial, and industrial strength of the nation, and on the high purpose and abilities of the forestry profession. I am unwilling to admit that we should concede a lower standard that would lead to a national attitude of drift under pressure of the many obstacles that today appear to clog progress. I regret to admit that some factors in the present situation appear to me as trends in this direction.

"It is now more than half a century since I embarked on my own work in forestry; and GIFFORD PINCHOT was several years ahead of me. I have recently reviewed the significant events during this long period in order better to appraise the extent of our accomplishments and the problems now confronting the country. One of the striking facts appearing in such an historic review is the length of time that was required to lay foundations for national forestry before much progress could be made in actual practice in the woods. Initial steps of developing federal and state policies, establishment of public forests and organizing their administration, creation of schools of forestry and building a profession, inauguration of research and experiment, development of technology of forest protection, and education of the public to the significance of forestry; all these were essential basic undertakings.

"We certainly have now reached the point of moving forward, not only in strengthening and expanding policies and undertakings already inaugurated, but in forwarding on a large scale the practice of forestry on private lands. While foresters have been deeply preoccupied with current duties on war work or otherwise, they are giving thought to preparation for postwar problems in forestry. I am convinced that we have ahead of us the greatest opportunity since the initiation of forestry in the early days to take a long step forward after the war. I believe that the country is ready for it.

"*Factors Affecting Progress.* — In connection with my duties as chairman of the Joint Committee of the National Research Council and the Society of American

Foresters, I have devoted special study during the past two years to the factors that bear on progress in different lines of endeavor. Such an analytical study reveals special difficulties and obstacles that tend to retard or actually block progress. Some of these obstacles are economic and present pretty tough problems, but I am confident that they are susceptible of progressive solution. This requires, however, a common recognition and understanding of them by foresters and others concerned, and requires a concerted attack on them. But can we get concerted action by foresters in some of these problems?

"The features which give me special concern center around differences of opinion and controversies regarding basic policies in forestry and fundamental standards of practice. I refer to controversies regarding federal and state functions and responsibilities, conflicts in policy and administration of publicly owned lands, public regulation of cuttings on private lands, standards of silviculture and management, and, regionally, various other features.

"I understand that proposals are being made to transfer portions of the national forests to states and even to private ownership. I do not know how extensive such proposals are or how widely supported. But I do know that there has developed in certain regions increasing pressure against enlarging the national forests by purchase or otherwise. I have always asserted and still insist that the national forests are the bulwark of American forestry. In my opinion their enlargement should have an important place in postwar planning in forestry. And in this I do not overlook the definite place of state forests.

"Have we not reached the point of taking definite leadership in bringing about the unification of administration of forests, parks, and other properties owned by the federal government? Such action must ultimately be taken. It seems to me that we should take the initiative in such a reform.

"Public regulation of private forests is of course the most controversial question of public policy. I shall not precipitate a debate by repetition of my own position in the matter, which I have often stated. I wonder whether this and other differences among foresters are going to stand as real obstacles to a position of leadership in forestry by the United States among nations.

"You may wonder what my reference to the special problems of forestry in the United States has to do with the plan of international collaboration in forestry. Certainly no international agency is going to tell us in this country what we should do in forestry. But I believe that there will be a stimulus to higher standards of achievement in forestry through participation in this world movement. I wish that American foresters could sit with representatives of other countries in discussions of public regulation. The principle of regulation is simply taken for granted in many other countries.

"*An Opportunity for the Profession.* — I am personally close enough to the various problems to appreciate the difficulties faced by foresters in meeting them. It will require vision, courage, patience, and high technical skill to resolve these problems, qualities that are possessed in high measure by the profession. Above all it is necessary to keep constantly in mind the broad national goal of a balanced forest economy and need of high standards of achievement that are feasible and may be expected of the United States. With the progressive depletion of the natural timber reserves and the vast extent of degraded forest that must be restored and rehabilitated, I recognize that the larger objectives will be attained only by progressive steps. But there always should be the consciousness of moving forward, improving practices in silviculture and economic utilization. In the years ahead when the forester looks back over his career, his greatest satisfaction will be in the measure of improvement and enlarged contribution in the special field for which he individually is responsible.

"What an opportunity for our profession and for every one of its members!"

**A Conference of Middle East Agricultural Developments** was held in Cairo from Feb. 7/10, 1944. The *Proceedings* have recently been published and may be obtained from the Secretary's Office (10, Sharía Tolumbat, *Cairo, Egypt*). Delegates at the conference included Aden, Cyprus, Egypt, Iraq, Lebanon, Palestine, Saudi Arabia, Sudan, Syria, Trans-Jordan and representatives from the Middle East Supply Centre, Scientific Advisory Commission and the Agricultural Development Staff.

The work of the conference was divided into five main sessions. The first was concerned largely with irrigation and dry land farming. The second examined the possibilities of reclaiming and developing new areas of land and the third reviewed the problem of preventing waste of agricultural resources through soil erosion and river silting. The fourth session considered the possibilities of improving agricultural technique and practice through the further development of research, extension work, and agricultural education, and the final session was devoted to studying some examples

of agricultural problems which are essentially regional and the solution of which must depend on concerted action by the countries concerned. The concluding session adopted a number of resolutions which are broad in scope yet specific in objective. The conference was apparently launched as an experiment but it was felt that the experiment had justified itself and was well worth repeating.

**A "First International Orchid Congress"** organized by the Mexican Society *Amigos de las Orquideas* was held in Tuxtla Gutierrez, Chiapas, Mexico, April 12/21, 1943. A report will be found in the Am. Orchid Soc. Bulletin of April 9, 1943 and following numbers. — The American Orchid Society Bulletin is at present being edited by our associate, Mr. GORDON W. DILLON. Nearly each number of this interesting journal contains material of an international and often of a very general interest. The printing of the journal was transferred, some time ago, to the Harvard University Press, which — after certain changes in its staff — has recently assumed the technical care of several other journals edited by Harvard scientists.

**International Objects of Forestry Documentation:** — In a recent article in Intersylva, the journal of the International Forestry Centre in Berlin, Dr. FRANZ GRÜNWOLDT* emphasizes the present unsatisfactory state of "forestry documentation" and consequent difficulties in obtaining timely information on current silvicultural works. As a remedy he proposes the establishment of a large international library. Aside from its immediate function, this institution would be concerned with the publication of current bibliographies, the preparation of technical translations, and the maintenance of cinematographic and pictorial archives. Among other aims of the proposed international center would be "to safeguard the interests of forestry within the scope of general documentation and to establish the importance of documentation in the science and practice of forestry."

The elaboration of these ideas consumes fifteen pages, but the writer's arguments are not too convincing. The all-important problem — who is going to provide the funds for this magnificent international treasury of silvicultural wisdom — remains open. Because of the differences in the mode of production and the availability of capital, forestry will never be in a position to duplicate agriculture in the scope of its international organizations.

A complete library, including the world's literature, is an invaluable asset to any profession. The establishment and maintenance of such libraries, however, for obvious reasons, is a matter of *national*, rather than *international* concern. The United States, Soviet Russia, and many other countries already have enviable collections of forest writings that need only to be brought up to date through purchase or exchange of issues when the war is ended. A library devoted exclusively to forestry would duplicate many of the volumes available in agricultural libraries.

The spread of information through translations of valuable works or incorporation of new findings in text books is the business of college professors and research workers, but hardly that of hired clerks lacking in expert judgment of the subject. A widely organized international exchange of teachers, graduate students, and men of practice, in my opinion, would be the most efficient means of disseminating silvicultural knowledge and of arriving at a broader, more scientific approach to forest management. The present, generally inadequate ability of foresters to read foreign languages is a factor to be considered.

Foresters are badly in need of an international review or abstract journal such as the Zeitschrift für Weltforstwirtschaft. However, an organ of this kind no doubt will be established after the war on a sound commercial basis and with no financial involvements of international character. There are indications, supported by weighty reasons, that English will replace the three languages formerly used in the international relations of foresters.

The materialization of some of the author's proposals would merely duplicate the work of an international forestry congress. Other proposals, such as "safeguarding the interests of forestry," appear to be vague and superfluous. (S.A.W.)

* F. GRÜNWOLDT 1941: Les Tâches Internationales de la Documentation Forestière (Intersylva 1, 2:215-231, 1941).

**The Third Inter-American Conference on Agriculture** will open in Caracas, Venezuela, on July 24, 1945. Señor MANUEL AROCHA is acting as the general secretary of the organizing committee. — There will be 6 sections: Money and agriculture; Present agricultural production and its adjustments to the postwar period; Foodstuffs and raw materials; Markets and transportation; Agricultural migrations in the postwar years; and Agricultural statistics. — The programme of the sectional meetings is quite extensive. We have unfortunately not been able to obtain any data about the principal scientists which will attend the meetings.

**Esperanto for Scientific Purposes:** — Dr. D. R. DUNCAN reported some years ago (the Sci. Worker, Feb. 1938) on the use and possibilities of Esperanto for scientific purposes. This article is very timely in connection with various recent discussions of the language problem in science.

"There is little need to stress", Dr. DUNCAN wrote, "in scientific circles the difficulties in which we are involved as a result of diversity of language. It may be estimated that a person knowing only English is able to read not more than thirty per cent. of the original scientific papers appearing at the present time, whilst a knowledge of at least twenty languages would be necessary in order to read all the more important papers. An attempt is made to remedy the situation by the publication in the leading languages of abstract journals containing summaries of papers published in all parts of the world, but the proportion of valuable papers covered by the abstracting journals is not large; according to figures given by Dr. S. C. BRADFORD (*Chem. & Ind.*, 1937, 56, No. 43, 947-951) as the result of a careful investigation of the matter, only about a third of the papers of real value ever reach the abstracting journals, whilst the abstracts which do appear in these journals of papers in relatively little-known languages such as Japanese or Chinese, or even Russian or Czech, are frequently very short and far from accurate, owing to the difficulty of finding abstractors who possess at the same time the necessary linguistic ability and a sufficient scientific or technical knowledge of the subject of the paper.

"As a further result of the diversity of language, abstracts of the same article appear in a number of different languages. An economy of over fifty per cent. in the expenses both of the abstracting bodies and of the journal-purchasing public could be effected if any one language could be adopted as the common language for all scientific abstracts.

"The language difficulty is also met to some extent by the insertion, at the end of a paper in one of the minor languages, of a summary in some more widely used language. This practice is followed by a number of journals in Japan, Rumania, Russia and other countries, but loses efficiency owing to the fact that the writers of the summaries frequently lack ability in the use of the major language. Thus, many summaries of Japanese papers are in a kind of 'English as she is spoke' which is almost unintelligible. Even an accurate abstract is but a poor substitute for the original paper, since it is impossible to judge the reliability of the work merely from a summary lacking the full experimental evidence or details of the theoretical reasoning. The absence of a common language is also felt acutely at international symposia. The language problem is, of course, not confined to scientific circles. It is a source of difficulty in international affairs, not merely in actual meetings between politicians or diplomats, as, for example, at the meetings of the League of Nations, but also through preventing the interchange of ideas and points of view between the peoples of different nations. The dissemination of a common language would make it more difficult to arouse a war mentality or to instil into the people a distorted point of view, as is done in certain countries at the present time.

"It was this fact which led a young Polish scientist, Dr. L. L. ZAMENHOF, to put forward in 1887 the international language Esperanto as a solution to the problem. It was soon realised that the language would also be of considerable use in travel and in commercial relationships, and Esperanto delegates have been established in all the leading towns of the world, from whom assistance may be sought in any case of difficulty. Addresses of these delegates may be obtained from the Internacia Esperanto-Ligo, Heronsgate, Rickmansworth, Herts. It is impossible to give reliable figures for the number of Esperantists in the world, but the extent to which it has been taken up may be judged from the fact that, during 1936, there were 1838 broadcasts in Esperanto from 86 radio stations in 19 different countries, and that there are 97 current Esperanto periodicals published in 32 different countries.

"In the construction of Esperanto, ZAMENHOF aimed at producing an easily understandable, easily learnable language, capable of expressing the finer shades of meaning, and this end he attained by the adoption of a simple but logical grammar and the selection of root words which occur in as large a number of languages as possible, further words being formed by the use of affixes. The language is written phonetically and when spoken sounds very much like Italian.

"ZAMENHOF, as a scientist, realised the need for an extended scientific vocabulary, but also observed that the majority of scientific and technical terms are very international in character. Accordingly, he recommended that all such terms should be used freely in Esperanto, irrespective of whether or not they appear in the official vocabulary, but that they should be spelt phonetically according to the Esperanto system in order to avoid the patchwork effect observed in many national languages which have adopted foreign scientific terms to fill gaps in their own vocabulary. The matter has been studied more fully by the Internacia Scienca Asocio Esperantista, a body founded in 1906 by members of the French Académie des Sciences, who have published various books outlining the principles to be followed and including lists of technical terms used in various sciences. They have also been assisted by various outside bodies concerned in the international standardisation of scientific terminology, who have included Esperanto among the languages considered.

"Esperanto has been used extensively for the publication of popular scientific books and articles in Esperanto periodicals. Of greater scientific interest are the *Bulteno de Internacia Scienca Asocio Esperantista,* which contains short accounts of published researches similar to the Research Items in *Nature* and longer monographs on scientific subjects, and the *Internacia Medicina Revuo,* an abstract journal covering medical papers.

"The use of Esperanto for scientific publications by non-Esperantist bodies has made most headway in Japan. Original papers in Esperanto occur from time to time in the *Scientific Papers of the Institute of Physical and Chemical Research,* while the Institute for the Study of Social Problems and the Japanese Pharmacological Society give Esperanto summaries at the end of their papers. This practice is followed in a few journals outside Japan, *e.g.,* the *Bul. Soc. Française des Electriciens,* the *Phare médical,* and the *Revista da Sociedade de Geografia do Rio de Janeiro.*

"The reports of the Aerological Observatory at Tateno are published regularly in Esperanto. These reports consist largely of tables of figures, with headings and explanatory notes in Esperanto. Since Esperanto is intelligible to any educated European without previous study, the extension of this practice to other publications consisting largely of tables, in place of the parallel columns in different languages used in works such as *International Critical Tables,* would not merely reduce the cost and bulk of such books, but would increase the number of countries in which they could be used without linguistic difficulty. It is no exaggeration to say that the average English scientist, with no previous knowledge of Esperanto, could read a text in this language more easily than he could a text in German, which he is presumed to 'know.' The writer has used Esperanto for correspondence with foreign research workers without experiencing any difficulty.

"The suitability of Esperanto for use in symposia is amply demonstrated each year at the 'Somera Universitato,' held during the annual 'Universala Esperanto-Kongreso.' This congress takes places in a different country each year and is attended by some thousand delegates from thirty or more countries. The Somera Universitato consists of a series of lectures on scientific and other cultural subjects, given by University professors and people of similar standing, followed in each case by a discussion. This year the meetings will be held at University College, London, from the 30th of July to the 6th of August.

"The advantage of Esperanto over any chosen national language, such as English, French or German, for use between people of different nationalities, lies primarily in its ease of acquisition and the fact that its use does not unfairly favour any one nation. When conversing in Esperanto, neither party feels at a disadvantage in that he is speaking in a foreign language with a native speaker of that language. The clarity and precision of the language, due to its scientific and logical construction, render it eminently suited for scientific purposes.

"Mi konkludas per paragrafo en Esperanto. Esperanto prezentas al la scienca mondo la sole efektivan solvon de la lingva problemo. La lingvo estas logike konstruita el internaciaj elementoj, kombinitaj en harmonia maniero, facile lernebla de ne-instruita homo kaj komprenata sen studo de bone edukita persono. La praktika merito de Esperanto estas nedisputebla."

**Woods Hole Memorandum concerning Rehabilitation of Basic Biological Sciences during the Post War Period:** — A group of biologists, including Drs. D. V. Bronk, R. Chambers, P. S. Galtsoff, Otto C. Glaser, C. W. Metz, Charles Packard, Lawrence Saunders, and H. B. Steinbach, who worked at the Woods Hole Marine Biological Laboratory during August 1944, framed the following memorandum, which was sent to the Div. of Cultural Relations of the (U.S.) Dept. of State, Washington, D. C., etc.:

"We feel that the coöperation of American scientists is essential in rehabilitation of the basic sciences in the war stricken countries. This is because we are convinced that the maintenance of proper economic and cultural conditions in America depends on scientific progress in all countries.

"The international scope of scientific endeavor provides one of the surest approaches to mutual understanding and good will. Moreover, progress in the basic sciences today requires, more than ever before, active and continued coordination throughout the scientific world. Our participation in the rehabilitation program presents the opportunity for furthering such coordination in the post war world.

"In order to implement our aims we offer the following instances of ways in which American biologists can cooperate with the State Department.

"A. *International congresses.* — A special international convention of biological scientists should be held as soon as possible after the cessation of hostilities. This would be an effective aid toward the rehabilitation of biological research and future coordination of our scientific endeavors. How this convention is to be assembled and how constituted requires careful consideration. At this meeting many of the points included in this memorandum could be profitably considered and plans instituted for definitive action. As instruments for the dissemination of scientific knowledge international congresses in the past have been very effective. We should like to see such congresses re-established as promptly as possible and made more frequent.

"B. *Scientific representatives.* — The interests of the basic sciences should be represented in the State Department and the embassies. On this matter we wish to emphasize the peculiar fitness of theoretical and experimental biologists, since wide scientific training is necessary in their research, and such biologists are guided by little or no commercial motivation. Disinterested appraisal is essential in the restoration of scientific investigation and of our international relationship thereto. Biological scientists are in a position to be helpful in the selection of such representatives.

"C. *European scholars,* as they desired, should be aided in starting their own work in their own countries as quickly as possible. The initiative in all reconstruction should rest with those best able to judge local situations, namely the citizens of each country in question.

"D. For the prompt rehabilitation of European students and research workers in the basic sciences we suggest a system of short and long term fellowships, to be put into operation in our

institutions. For short term fellowships we suggest the use of summer laboratories. Among these the Marine Biological Laboratory at Woods Hole offers unique opportunities for contacts with leading biologists of the country.

"E. We approve a program for the support of international institutes of research and higher learning.

"F. It is important to complete the files of American journals in foreign countries by the collection of back sets. Scientists in all our institutions should be encouraged to offer their services in the preparation of lists of the American scientific journals which the State Department may wish to provide for foreign laboratories. There is also the question of assembling and distributing reprints.

"G. We understand that the Division of Public Information has under consideration the distribution of significant American books published during the last decade. Scholars in the basic sciences should coöperate in the selection of such books.

"H. Concerning apparatus and other equipment it is anticipated that there will be surplus supplies and equipment available for export. These should be sent to scientific centers abroad as soon as their needs and desires become known."

**Bacteriological Nomenclature:** — At the third International Congress of Microbiology held in New York City in September 1939 a series of recommendations of the Permanent International Committee on Bacteriological Nomenclature were accepted at the plenary session of the congress. The third and fourth recommendations were:

That the Nomenclature Committee, as at present constituted, shall continue to function under the auspices of the International Association of Microbiologists as it did under the International Society for Microbiology.

That the International Committee shall select from its membership a Judicial Commission consisting of twelve members, exclusive of members *ex officio,* and shall designate a chairman from the membership of the commission. The two permanent secretaries of the International Committee on Bacteriological Nomenclature shall be members *ex officio* of the Judicial Commission. The commissioners shall serve in three classes of four commissioners each for nine years, so that one class of four commissioners shall retire at every International Congress. In case of the resignation or death of any commissioner, his place shall be filled for the unexpired term by the International Committee at its next meeting.

By prompt action at and subsequent to the congress ballots were cast in spite of war conditions by twenty-six of the sixty-two members of the Permanent Committee on Nomenclature. These ballots when examined by the undersigned joint secretaries of the committee in November 1942 were found to have resulted in the selection of those whose names appear below. These are grouped in the three classes specified by the permanent committee, those receiving the highest number of votes being placed in the nine-year class, those receiving the next highest in the six-year class, etc. Names in the classes are arranged alphabetically:

*Elected for nine years* (term normally expires in 1948): R. E. BUCHANAN, U. S. A.; A. J. KLUYVER, The Netherlands; E. G. D. MURRAY, Canada; S. ORLA JENSEN, Denmark. *Elected for six years* (term normally expires in 1945): J. HOWARD BROWN, U. S. A; A. R. PRÉVOT, France; J. RAMSBOTTOM, Great Britain; Th. THJÖTTA, Norway. *Elected for three years* (term normally would have expired in 1942): A. LWOFF, France; R. RENAUX, Belgium; A. SORDELLI, Argentine; C. STAPP, Germany.

It has been decided to make this announcement in the hope that some plan for taking tentative action on questions of nomenclature can be developed by those members of the commission who can be reached under war conditions.

While no provision was made in 1939 for the contingencies that have arisen, it is felt that those elected should serve until successors are elected. Professor R. E. BUCHANAN has been asked to act as chairman *pro tem.* of the Judicial Commission as there is no possibility of securing an election under the rules as adopted. (R. ST. JOHN-BROOKS, and ROBERT S. BREED, *Joint Permanent Secretaries, International Committee on Bacteriological Nomenclature*).

**The International Union of Forest Experiment Stations:** —

*Seed Source Experiments with Larch.* — The International Union of Forest Experiment Stations continues to be active during wartime through its Commission on Tree Seeds and Tree Races. A new project was initiated last spring for the testing of different sources of European larch (*Larix europaea*) and in the fall of 1943 some 60 different origins had been obtained for distribution to coöperators. In addition a few samples of *Larix leptolepis* and *L. sibirica* were available. The different lots of *L. europaea* are to be divided into 10 groups, and each participant is urged to include one source from each group in his plantings, in case he cannot undertake the more elaborate experiment involving the entire series. Plans are being made to distribute the seeds in time for sowing in the spring of 1944.

After seedlings have been grown according to a standard procedure in nurseries, each coöperator is expected to set out 500 plants of each origin, distributed in 5 replications of 100 plants each. The small trees are to be planted 1.5 × 1.5 M. or 4444 plants per hectare at the beginning, and thinned to half that density at the end of 10 years. In arranging the plots, the long side of the plots should follow the slope of the ground. In order to eliminate marginal influences as far as possible, it is recommended that trees grown from a "standard" seed lot (preferably one native to the country) be planted around the border of each plot.

It is expected that this experiment will yield valuable information on the racial characteristics of larch, and indicate what sources of seed are most desirable for planting in each country and climatic region. European larch and other exotic larches planted in America have often suffered from injury from animals, birds, insects and diseases more than normally in their native habitat. It is possible, however, that some sources of seed might be less susceptible to such injuries. The distribution of seeds is being made by the Secretary-General of the Union, Jägmästare SVEN PETRINI, Experimentalfältet, Sweden. (H. I. B.)

**The first International Provenance Experiments:** — In an article in Medd. Skogsförsöksanst. Stockh. 33:247-266 (1942), Dr. S. PETRINI, the Union's active secretary reports some interesting historical data. The first international provenance experiments with Scots Pine (*Pinus sylvestris*) were started in 1907. The series included twelve different provenances: — Scotland, France, East Prussia, Belgium, Bavaria, Kurland, Brandenburg, Russia (Ural), Bulgaria, North Hungary, West Hungary, and Sweden (Lapland). The series was planted at 18 different places and at least two-thirds of the plots have since been destroyed. The Swedish plot is located at lat. 57° 38'N., long. 15° 37'E. The soil is ordinary moraine. In this locality the Kurland (Riga) Pine has given best results both as regards volume production and timber quality (straightness, size of branches and knots). Next comes the Scottish provenance (Inverness, 57° 14'N., 3° 42'W.). The Swedish Pine from the northernmost part of the country, here growing in southern Sweden, is in fourth place after the East Prussian provenance. Of the remainder, the Pines from Bulgaria and Russia (Ural) are of excellent quality though their volume production is less than average. (*Courtesy Forestry Abstracts.*)

**The Inter-American Soil Science Society:** — Dr. H. H. BENNETT (CHRON. 3:277*b*, 1937, Pl. and Pl. Sci. Lat. Am., pp. 165/169) writes us: "A resolution was approved at the Second Inter-American Conference of Agriculture in Mexico City in 1942 to establish an Inter-American Soil Science Society. A technical committee of five members was appointed to draft a constitution and determine what societies of that nature existed. The Committee reported this past July and, since there was some question with regard to satisfaction on the part of all Countries of the Americas, the constitution was referred to the Pan American Union. The matter has been called to the attention of all the governments involved by the Pan American Union. It is likely that each government will delegate a representative with power to vote on the constitution at the meeting scheduled for Caracas, Venezuela next July.

"Gathering soils and land information in the Americas is going forward rapidly but until there is a complete meeting of minds, no uniform procedure can be developed. It is hoped that on adopting the constitution a committee can work out procedures for making a soil map of the Americas that will have continuity."

**Colonial Research in The British Empire:** — The survey of Colonial research in the British Empire prepared by Dr. LUCY MAIR (*Agenda* for October) is of particular interest at the present moment. Under the Colonial Research Committee appointed in June 1942, a comprehensive survey is at present being made, as the first work of the Committee, of the facilities existing in Great Britain and the Colonial Empire, both for research and for the training of research workers. Pointing out that research in the Colonial field has tended in the past to be directed to the overcoming of practical difficulties that have already been encountered, Dr. MAIR emphasizes that the present demand for a planned and consciously directed welfare policy is not a demand for something entirely new, but for more effective measures in the pursuit of aims already accepted. In regard to research by administrative officials, while those responsible for the conduct of policy in the Colonial Empire are fully aware of the need for knowledge of every aspect of the lives of its native populations, such inquiries, often limited in scope by the difficulty of finding time for them amid the pressure of other work, and carried out by those who have no specialized training in research in the relevant subjects, have not had a scientific value on a level with that of work done by trained specialists devoting their whole time to research.

In social anthropology, the London School of Economics, where B. MALINOWSKI held the chair

from 1926 until 1942, is the centre for this work in Great Britain. A great expansion in research was made possible by the Rockefeller Foundation which, after adding social anthropology to the subjects qualifying for its research fellowships, made a generous grant to the International Institute of African Languages and Cultures. The latter body from 1931 until the outbreak of the war played a leading part in financing the training of social anthropologists and research by them in Africa. Chairs of social anthropology have been founded at Cape Town and Sydney, and research workers trained at these universities, and also at the Department of African Studies of the University of the Witwatersrand, have undertaken field-work in the adjacent Colonial areas of Africa and the Pacific. While such field-work is in suspense, a special advisory board in Colonial studies constituted in 1941 has undertaken a review for the University of London of the achievements and potentialities of the various social sciences in regard to Colonial research.

At the London School of Economics a Colonial Research Division has been set up to co-ordinate work on the various subjects which have Colonial aspects. Linguistic research in Colonial areas of a most practical kind is the work of the School of Oriental and African Studies (University of London), while the Colonial Department of the University of London Institute of Education has as its primary object the training of teachers for work among Colonial peoples but has also encouraged research on educational problems. The Oxford University Social Studies Research Committee organized in 1938 a co-operative expedition to Kenya, in which two anthropologists, an expert in Colonial administration, an economist and a geographer collaborated. The principal centre at Oxford for sociological research on Colonial questions is now Nuffield College, where a programme of research has been organized including a study of the economic problems of Nigeria and the Gold Coast, a comparative study of the various political institutions which have been developed under British rule in tropical Africa, and a study of the institutions, official and unofficial, through which economic policy is formed and executed.

In addition to the universities, the International Institute of African Languages and Cultures was also in peace-time an important institution for the organization of sociological research in Africa, and the war has prevented the completion of a plan to establish in Northern Rhodesia a Rhodes-Livingstone Memorial Institute as the first centre in Africa itself for the special study of problems arising out of the relations between local peoples and other races. Dr. MAIR's survey also includes a brief reference to the London School of Hygiene and Tropical Medicine and the Liverpool School of Tropical Medicine, as well as to other medical research institutes in the Colonial empire where research in tropical medicine, in nutrition and in other health matters is carried out.

There are numerous institutions in the Colonies and in Great Britain which are concerned with agricultural and veterinary research and assist Colonial research workers with information and technical advice. Fishery departments have made surveys of local resources in Palestine and in West Africa, while in Malaya the Fisheries Department has concentrated its attention on raising the efficiency of this native industry. In the Colonial empire the most extensive forestry research has been done in Malaya by a well-equipped Forest Research Institute. The principal centre for forest research in Great Britain is the Imperial Forestry Institute at the University of Oxford, while research on the utilization of forest products is carried out by the Forest Products Research Laboratory, Princes Risborough, and the Colonial Forest Resources Development Department. A considerable amount of research has been carried out on the mineral resources of most Colonies by the geological departments, as well as by mining and oil companies, and this work has the assistance of the Mineral Resources Department of the Imperial Institute. At the present time, research on technical subjects has run far ahead of the study of social and economic problems, and Dr. MAIR suggests that the disproportion may be corrected by the influence of the new Colonial Research Committee, on which both the social and the natural sciences are represented. (*Nature*).

# the CHRONICLE

**Short Notes on Botanical Collections Lost or Damaged as a Result of War Conditions:* —**

(1) Not much information is yet available about the losses of the *Dept. of Botany of the British Museum of Natural History*. This is somewhat surprising as extensive and detailed accounts of the losses incurred by the Zoology Dept. have been published by members of its staff.[1]

(2) As we were the first to report (Science, June 18, 1943), most of the botanical collections of the *Botanical Museum in Berlin-Dahlem* have been destroyed. This report has been confirmed later (*cf.* E. D. MERRILL *in* Science, Dec. 3, 1943) but no detailed information is as yet available. Swiss and Swedish colleagues, in recent air-mail letters, state to know little about recent events in the Reich.[2]

(3) The collections of all departments of the *Paris Natural History Museum* are intact.[3]

(4) The *Botanical Garden and Museum at Caen* have been completely destroyed, all collections are lost.

(5) Dr. H. H. HU writes that all collections of the *Fan Memorial Institute of Peiping* have been removed to Tokyo.

(6) The collections of the *Sun Yat Sen University Herbarium,* which were left in Canton, were shipped to Taihoku (Formosa).

(7) The collections of the *Leiden Herbarium* and other Netherlands herbaria were in good condition, as late as September 1944, according to a message received via the International Red Cross.

(8) According to word received from our associate, Dr. W. ROBIJNS, Director of the "Jardin Botanique de l'Etat" of *Brussels,* the collections are all safe (it has been reported elsewhere that part of the gardens have been destroyed). Dr. ROBIJNS continues: "Unfortunately Dr. R. MOSSERAY, Assistant at the "Jardin botanique de l'État" and Officer in the Belgian Army, was killed in May, 1940. His death was a real loss for our Institute. — I am glad to say that, during the occupation, our scientific activity has not only been continued, but even extended. — The "Bulletin du Jardin botanique de l'État" was issued regularly, but only once a year. We made and started to execute a plan for a Flora of the Belgian Congo, that will comprise about 20 volumes for the whole of the Spermatophytes. The manuscript of Vol. I is nearly completed. — On the other hand, I started the preparation of a Flora of the Spermatophytes of the National Albert Park-Kivu region (Belgian Congo), which is finished about half way. — You may see that we have not lost our time during the occupation, and that we kept up our minds and our hope in final victory, by steadily preparing for the future!"

(9) From a communication, recently received by Dr. MERRILL from *Leningrad* we

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* *Cf.* also CHRON. 5: 249 *et ante.*

1 *Science* stated: "Information received from London indicates the most serious damage was caused by an incendiary bomb which fell on the roof of the east wing and penetrated to the foreign herbarium of the botanical department. A large number of plant specimens were destroyed, and many thousands of herbarium sheets were badly damaged by fire and water. It is understood that the Department of Entomology was also damaged. American botanists are of the opinion that many unrecognized type specimens of American and other plants were stored in the foreign herbarium, though a great deal of the most valuable material from several departments of the museum had been removed from London." — The *Journal of Botany* (Jan. 1941) reported: "It is now permissible to reveal that the British Museum (Natural History) has suffered damage from air attacks. The Department of Botany has been the most seriously affected, the General Herbarium having been set on fire. The loss by fire and the damage by water, though considerable, are not so great as would have been expected. It may be possible to give a detailed account in the near future." — As a result of these notes directors of North American herbaria have offered Dr. RAMSBOTTOM to make efforts toward filling certain lacunae known to exist.

2 Fortunately for the scientific world, the Chicago Natural History Museum, by means of its ten-year botanical project in Europe prior to the war, obtained photographs of most of the type specimens not only in the herbariums of Berlin, but also in Copenhagen, Munich, Vienna, Paris, Geneva, Madrid, and elsewhere — more than 40,000 photographs, including 15,800 from Berlin.

3 La libération de Paris ne s'est pas faite toute seule. Le 19 août, les drapeaux étaient mis à 11 heures sur les monuments de Paris, à midi, les Allemands tiraient sur le pont d'Austerlitz! (et ailleurs). Le 25 et le 26, on pouvait considérer que Paris était libéré — sauf de rares points. Vous troupes et celles du général LECLERC ont été accueillies avec une joie, un enthousiasme que vous devez imaginer. La situation matérielle s'améliore un peu: métro à peu près normal, l'électricité revient, le gaz un peu — mais le charbon pour cet hiver? — Au Muséum, 2 or 3 petits bâtiments ont été touchés lors du dernier bombardement le 26 août. Les collections sont intactes. Le personnel aussi — sauf HELM déporté en Allemagne, et maintenant au Tyrol (s'il vit toujours) et HAMEL (de la cryptogamie) tué sur une route en allant au devant de vos soldats. (Dr. PAUL JOVET *in ep.* to Dr. L. CROIZAT).

learn that the very large and important herbarium and library at the *Komarov Institute of Botany* (*Principal Botanical Garden*) suffered no damage during the siege of Leningrad although many bombs fell in the grounds. Most of the living greenhouse collections were lost because of breakage of glass by bombs. The Siberian part of the important Turczaninow herbarium at Karkov was removed to Leningrad, and is safe. The general Karkov herbarium, however, as well as the collections of the Ukrainian Academy of Science at Kiev and the Nikita Botanical Garden near Yalta in the Crimea were confiscated and supposedly moved to Germany.

(10) The large exotic *moss Herbarium* of I. Thériot of Fontaine-la-Mallet, which was in the invasion zone, is safe.

(11) The *Bureau of Science at Manila,* its immense collections in botany and zoology as well as its fine library, the results of almost half a century of work were destroyed completely during the reoccupation of Manila.—*See p. 191 for further details.* The herbarium contained in excess of 300,000 mounted specimens.

(12) From a letter of Dr. M. Bouly de Lesdain (Dec. 12, 1944), to Mrs. Agnes Chase, Ph.D.: "Ma maison située à Dunkerque a été entièrement brûlée avec *tout* ce qu'elle renfermait, à la suite des bombardements du mois de Mai 1940. — Je ne possède donc plus ni bibliothèque ni herbier. — Comme je désire continuer mes études sur les Graminées, et *surtout* sur les lichens, je vous serais très reconnaissant, si grâce à votre bienveillante intervention, Smithsonian Institution pouvait me faire le grand plaisir de me donner quelques ouvrages sur ces végétaux." — Some of our readers may be able to send Dr. Bouly de Lesdain reprints and dupla.

(13) A U.S. correspondent in Germany writes: "In connection with checking on some herbaria for you, I can say . . . there has been no damage to *Heidelberg* by either bombing or shelling, as the city is preserved as a "historic" spot. I have visited *Nürnberg* recently, and it has suffered tremendous damage. Even the walls of the "old city" are almost destroyed in places, and throughout large areas all of the buildings are bombed and burned out. The city of *Frankfurt-am-Main* is almost completely destroyed, as are also *Mainz* and *Coblenz*. The university city of *Marburg* has suffered no damage at all, and the university buildings are in perfect shape." — The same correspondent reports as follows about the Jardin des Plantes in *Paris* (*see also above*): "I visited the Jardin des Plantes the first week of April, and it appeared to actually be in better condition than when I visited it in 1938. The Botanic beds were being carefully tended by sufficient workers, and specimens which had died were being replaced. The conservatory there, however, was unkept because of lack of fuel for heat, and all of the plants had perished".

(14) Phytohistorians will be glad to know, according to word received by Dr. Sarton, that the stock of *Isis* and *Osiris* at Brugues is safe.

— *these notes will be continued in Chronica 10* —

*U.S.A.:* **A Symposium on Wood Sugar:** — Four years ago it was apparent that a serious shortage of starchy raw material and of cereals in particular would develop because of the increased demands for these materials for feeds, for the production of alcohol by fermentation industries, for the production of starch and sirups by the wet-milling industry, and for Lend-Lease. The Chemical Referee Board of the Office of Production Research and Development, War Production Board, therefore, recommended that experimental work on the utilization of wood or wood wastes for the production of alcohol be thoroughly explored.

The decision of the Office of Production Research and Development to explore the possibility of obtaining ethyl alcohol from American woods was prompted by the enormous increase in the need for alcohol during 1942 and 1943 to manufacture synthetic rubber and explosives and by the parallel inroads made on the Nation's corn and wheat supplies to meet these needs. From estimates, it appeared that there existed a potential annual production of 150,000,000 gallons of ethyl alcohol from waste wood available in the form of sawdust, shavings, chips, and other refuse of lumber production at centrally located sawmills. Such a level of production, it was estimated, would relieve the pressure on dwindling stocks of grain to the extent of 60,000,000 bushels a year. In addition, the possibility of producing fodder-yeast stock feeds and lignin plastics as byproducts of alcohol production from wood was taken into consideration.

As a result of the efforts of Doctors D. B. Keyes, W. L. Faith, and J. A. Hall of the Office of Production Research and Development, work on wood sugar by indus-

# THE TRAGIC DESTRUCTION OF THE COLLECTIONS OF THE BUREAU OF SCIENCE IN MANILA

DEFINITE word has been received from reliable correspondents in Manila that the Bureau of Science, with its immense collections in botany and zoology (incl. entomology) and the fine library was destroyed completely during the reoccupation of Manila.

This dramatic loss of the results of many decades of strenuous work by such men as Drs. MERRILL, COPELAND, FOXWORTHY, ELMER, ROBINSON, MCGREGOR, BANKS, SCHULTE, TAYLOR and HERRE, and their collaborators, has been offset to a certain extent—particularly in the field of botany—as a result of the wise and liberal policy of large-scale distribution of duplicates. This policy was initiated at a time when such procedures were less common than today by Dr. E. D. MERRILL, who sent thousands of specimens to institutions in Washington, New York, Cambridge, Mass., London, Paris, Berlin (*see p. 189*), Leyden, Geneva, Leningrad, Singapore, Calcutta, Buitenzorg, Sydney and other important centers. Many of us, although we have never been in Manila, know the characteristic labels of the Bureau of Science herbarium (*see the illustrations*). It is gratifying to realize that so many specimens, often isotypes of the species described by the able staff of the Bureau of Science, are safe and available today as a happy result of the wise policy of Dr. MERRILL and his associates. Some thousands of holotypes, however, are lost forever, as well as an even larger number of isotypes sent by other institutions to Manila.

**FLORA OF THE PHILIPPINE ISLANDS.**
**HERBARIUM, BUREAU OF SCIENCE.**

*Common name* .................... *Dialect* ..........
*Field No.* .................. *Herbarium No.* ..............
*Collector* G. Lopez
*Island or Province* Coron, Palawan
*Locality* Banoangtagui
*Habitat* along the old caingin on mount
*Altitude above the sea* low alt. *meters.*
*Tree; shrub; bush; vine; herb* Tree
*Height of plant* 2-3 *M.*
*Diameter, breast high* 4 *Cm.*
*Flower* White
(Odor, color, etc.)
*Fruit* Blue
(Kind, odor, color, etc.)
*Special notes* ..............................
*Economic uses* ..............................
2—569

*Date* Sept. 17, 1922

BUREAU OF SCIENCE No. 26289

**FLORA OF THE PHILIPPINES.**
**HERBARIUM, BUREAU OF SCIENCE.**

Premna congesta Merr.

MT. UMINGAN
PROVINCE OF NUEVA ECIJA
LUZON
M. RAMOS
Coll. G. EDAÑO AUG.-SEPT. 1916
9—107

try, universities, and the Government was vigorously prosecuted. The results of much of this work were first made public at a symposium organized and conducted by G. E. HILBERT at the meeting of the American Chemical Society held in New York City from September 11 to 15, 1944.

Practically all of the important groups in the United States and Canada which have been engaged in the conversion of cellulose wastes for the manufacture of alcohol were present at this symposium. The program consisted of the following papers:

W. L. FAITH: Development of the Scholler Process in the United States.

E. C. SHERRARD and F. W. KRESSMAN: A Review of Wood Saccharification Processes in the United States Prior to World War II.

C. A. SANKEY: Ethyl Alcohol from Waste Sulphite Liquor.

ELWIN E. HARRIS, EDWARD BEGLINER, GEORGE J. HAJNY and E. C. SHERRARD: Hydrolysis of Wood in a Stationary Digester by Successive Treatments with Dilute Sulfuric Acid.

R. H. PLOW, JEROME F. SAEMAN, H. DALE TURNER, and E. C. SHERRARD: Single-Stage and Multistage Hydrolysis of Wood in the Rotary Digester.

JEROME F. SAEMAN: Kinetics of the Hydrolysis of Wood and of the Decomposition of Sugars in Dilute Acid at High Temperature.

REID H. LEONARD and GEORGE J. HAJNY: Fermentation of Wood Sugars to Ethyl Alcohol.

J. W. DUNNING and E. C. LATHROP: A Continuous Process for the Saccharification of Agricultural Residues.

W. H. PETERSON: Fodder Yeast from Wood Sugar.

R. L. HASCHE: Byproducts of Wood Saccharification.

ROBERT S. ARIES: Economic Considerations in the Production of Wood Sugars and Alcohol.

It was generally concluded that, from the information on saccharification processes now available, the production of alcohol from wood wastes under ordinary conditions is economically not feasible unless the industry is subsidized. (G. E. H.)

*Ecuador:* **Forest Developmental Work** (*cf.* also Pl. and Pl. Sci. in Lat. Am., pp. 304 and 306): — Ecuador's large forest resources, now exploited only in small part, offer promise for economic development, says a report by the Ecuadoran Commission of Inter-American Development, received by the Inter-American Development Commission, Washington.

Tropical woods, particularly, may find their way into the vast United States market, the report suggests. It recalls that in 1942 a mission of United States forestry specialists surveyed the Province of Esmeraldas, rated the richest wooded section of the country, to collect samples of woods having industrial value in the United States market. These woods include guayacan, moral, chanul, laurel, jagua, sande, pacora, cuisba, cara and chalvinde.

The report adds that certain businessmen, unidentified, have made studies of the possibility of establishing paper and other wood production industries in the Province of Esmeraldas. Of balsa wood, the report says: "Prospects for the future are even more promising than for any other product. In fact, at present only 400 hectares are under cultivation, while the districts suitable for this would easily exceed 700,000 hectares, including the vast areas along the banks of the Esmeraldas and Santiago Rivers, the districts of Tosagua, Calceta and Chone in Manabi, and the whole region in the provinces of Los Rios and Guayas now producing cacao, with these boundaries: Quevedo on the north, Boliche on the south, Catarama on the east, and Colimes on the west. It is estimated that production could be increased at least fifty times by intensifying cultivation and exploitation in these districts.

"There remains for the future only the problem of its price abroad which will determine its greater exploitation or decrease this completely.

"Cascarilla, or cinchona bark, is another forest product with a great future for Ecuador, since its present production is still insignificant. It is produced in the foothills of the Sierra and at present the forests are natural, especially in the Provinces of Azuay, Canar and Loja, although there are also trees in Esmeraldas, El Oro and Carchi. While present wild production is confined to the Sierra, its technical and scientific cultivation is more appropriate for districts of our littoral.

"Because of its importance in the manufacture of quinine and derivatives, a campaign has been started for its scientific cultivation and we do not doubt but that in a short time Ecuador will be able to export sizable quantities and at the same time will use it in industry. Right now certain foreign capitalists have established themselves in Ecuador and are interested in the utilization of domestic cinchona bark. The expanding of our chemical and pharmaceutical industries should constitute a sure market, within our own domestic economy, for this product."

# TWO MEXICAN LANDSCAPES BY J. M. VELASCO

A recent exhibit, in Philadelphia and Brooklyn, of paintings by JOSÉ MARÍA VELASCO (1814-1862), the Mexican artist, included many items of botanical interest. VELASCO was a great interpreter of Mexican nature and left many paintings and drawings which show, in a characteristic (rather accurate, yet romantic, sometimes slightly impressionistic) way, landscapes, vegetation types, flowers, animals, and even fossils, etc. — By courtesy of the Philadelphia Museum of Art we reproduce herewith two paintings from the recent exhibition.

Further details may be found in the interesting 80 page catalogue of the exhibition issued in 1944 by the Philadelphia Museum of Art and the Brooklyn Museum.

PLATE 14. *Puente de Metlac*, 120 x 151 cm., collection of Señora AMALIA SOLANA Vda. DE PÉREZ SALAZAR.

PLATE 15. *Hacienda de Chimalpa*, 104 x 160 cm., collection of Señor RICARDO A. PANI.

*Great Britain:* **A "Society for Visiting Scientists":** — The Society for Visiting Scientists was founded on the initiative of the British Council, and in consultation with the Royal Society, to provide a meeting place and information centre for men of science from overseas visiting Great Britain. The premises at 5 Old Burlington Street, W.1, consist of a lounge and meeting rooms, a bar, refectory, and some dormitory accommodation. These are at the disposal of members. The information centre is open to all visiting men of science, so anyone arriving in Britain can, if he wishes, proceed at once to the House and be given advice and details of how he can apply for membership. Under the present conditions it was decided to postpone the official opening for the time being; but the Society has been functioning unofficially for the last few months and has already been used by a number of British and foreign scientific workers, including members of the French Scientific Mission. It is hoped that an official opening will take place in the near future. In the meantime the Executive Committee has held an informal reception. On this occasion the president, Prof. F. G. DONNAN, pointed out the importance of offering hospitality to young scientific workers, and deplored the lack of facilities for them in the past. He added, "I hope sincerely that this modest beginning will be but the nucleus of something much greater and more widely spread, something that in the happy days to come will contribute to the friendship, intercourse, and good fellowship of scientists throughout the world."

*U.S.A.:* **A Conference on Plant Embryo Culture:** — A Conference on the culture of embryos and other excised plant tissues was held at Smith College, Northampton, Mass., for two and a half days, from July 14 to 16. The meeting was organized by the Smith College Genetics Experiment Station on a somewhat different plan from that of most scientific gatherings. There were no prepared papers and no speeches with a distinction between a speaker and an audience and the sessions were not open to the biological public. Instead the 36 specialists who attended* sat around a large table and took part in a free back-and-forth discussion of topics in which they could exchange experiences and make suggestions toward the solution of problems involved in the artificial cultivation of tissues apart from the parent plant.

The program was varied by trips to the Smith College Genetics Experiment Station, to the Massachusetts State College and Agricultural Experiment Station and by a tea given by Pres. and Mrs. HERBERT DAVIS, of Smith College, to those who attended the conference and to members of the biology departments of the four neighboring colleges—Amherst, Mount Holyoke, Massachusetts State and Smith. Smith College provided lodging for the conferees in guest rooms of the college dormitories. Other expenses of the conference were cared for by a grant from an outside source.

One of the features of the conference which met with general approval was its informality and lack of restraint that might have ensued if the members had felt their remarks were to be published. A suggestion that a detailed report of the proceedings should be assembled and sent around to those who attended was voted down. It was felt, however, that publication of a brief note on the organization of the conference and the topics discussed would be desirable.

An agenda was prepared and sent to the conferees before their arrival, which served, with slight modifications, as a basis for consideration of the problems which were brought up during the sessions. For each main topic a chairman was suggested who led in the discussion of the subject in which he was especially familiar. Speeches, however, were barred, and there was no transgression against the definition that a monologue continued for five minutes would be classified as a speech.

While naturally the discussions touched largely on matters of technique, it was early emphasized that the broad objective of fundamental importance toward which

* The investigators from other institutions were: JAMES BONNER, A. J. HAAGEN-SMIT and R. SIU, California Institute of Technology; LEWIS KNUDSON, L. F. RANDOLPH and L. G. COX, Cornell; ERNEST BALL, A. O. DAHL, P. R. GAST, H. J. SAX, KARL SAX and R. H. WETMORE, Harvard; R. E. CLELAND, Indiana University; J. VAN OVERBEEK, Institute of Tropical Agriculture, Puerto Rico; F. K. SKOOG, Johns Hopkins; H. B. TUKEY, New York State Agricultural Experiment Station at Geneva, N. Y.; R. F. DAWSON, Princeton University; P. R. WHITE, Rockefeller Institute at Princeton; W. G. WHALEY, U. S. Department of Agriculture; CARL LA RUE, University of Michigan; J. W. MARVIN, University of Vermont; R. A. BRINK, D. C. COOPER and A. J. RIKER, University of Wisconsin; HEMPSTEAD CASTLE and E. W. SINNOTT, Yale. Those from the Smith College Genetics Experiment Station were: A. F. BLAKESLEE, SOPHIE SATINA, A. G. AVERY, SARA BACHE-WIIG, LENETTE ATKINSON and the following student assistants: JEAN CUMMINGS, SUSANNE McLEAN, PEGGY LIEB, MARY SANDERS and CARMEN SANZ.

the conference might contribute was an understanding of factors in growth and differentiation from development of the egg through the embryo to the seedling and adult organs of the plant. Emphasis in the discussions was placed upon embryo culture, but similar problems are involved in the cultivation of other plant tissues in the study of which there were several specialists who took part in the conference.

The following main headings, which were further subdivided in the agenda, served as a basis for the detailed discussions: What each is doing and why; Objectives; Applications in genetics engineering; Instruments and methods of dissection; Seed dormancy relieved by embryo culture; Possible barriers to crossability; Morphological changes in growth and differentiation of embryos *in vivo* and *vitro;* Abnormalities in hybrid embryos; Micrografts; Infection by bacteria and molds; Why embryos fail to develop after starting; Physical requirements of media; Inorganic requirements; Organic requirements; Chemical nature of "Embryo Factor"; Effect of stage of development on nutrient requirements; Speeding up growth at different stages; Possibility of cultures in injected capsules; Special problems.

Those of us in the Smith College Genetics Experiment Station profited greatly from the many suggestions and new points of view that came out of the conference. This feeling of the value of the opportunity for exchange of ideas in a field in which all the conferees were actively carrying on research appeared to be shared by all who attended. The discussions at the conference gave evidence that increased research in embryo culture may be expected.

One has characterized the conference as "the most productive of any similar sessions which I have ever attended and I believe it is not too much to say that it has laid the foundation for the science of plant embryology in the modern sense." Whatever influence the conference may have on the future trend of botanical research it showed clearly to us who took part in its sessions that the problems of plant growth and development may be profitably attacked by experimental procedures, that development is controlled through a progressively changing internal environment, that an understanding of the environmental factors involved may be aided by study of tissues in cultures apart from the parent plant, and that further knowledge of these factors may lead to conscious control of a wide range of life processes. (A. F. B.)

*Costa Rica:* **Scholarships offered by the Inter-American Institute of Agricultural Sciences** (*cf.* CHRON. 7:333-336 and Pla. and Pla. Sci. in Lat. Am., p. xxi and p. 236): — During the first year of the operation of its training program, the Inter-American Institute of Agricultural Sciences in Costa Rica plans to offer 21 scholarships, one of each of the American republics, to advanced students in agriculture.

Buildings and other facilities are being completed at Turrialba, near San José, for the long-range work of the Institute. Started with an initial grant of $500,000 in funds from the Office of the Coordinator of Inter-American Affairs, the Institute now is supported by contributions from most of the other American republics, and functions under the Pan American Union.

Mr. J. L. COLOM, Secretary of the Institute, says that students who hold the degree of Bachelor of Agricultural Sciences or any equivalent degree will be eligible for the scholarships. Students will stay at the Institute from one to three years, devoting part of their time to organized courses and part of their time to research.

Continuing his description of the Institute's plans, Mr. COLOM adds:

"Four broad departments are planned: Animal husbandry, agricultural engineering, plant industry and soils, and economics and rural life. Each department will be directed by a chief, whose principal obligation will be that of organizing and carrying out the investigations and of teaching a number of graduate students.

"The plan is that no more than 10 graduate students will be assigned to each department, so that all may receive special instruction. In addition, the departments offer seminar courses, not only for students assigned to them but for all students.

"A group of distinguished scientists from the American republics will form the personnel and faculty of the Institute. They will be selected not only for their skill in the field of their specialty but also for their demonstrated ability to inculcate in their students some of the characteristics which made them eminent experts in their field.

"Technical research in the various fields of agriculture will receive major attention in the early years of the Institute. Experimentation in crops for the different republics

will extend and supplement the national programs of the various countries rather than compete with them."

*U.S.A.:* **The 36th Annual Meeting and War Conference of The American Phytopathogical Society** was held at the Netherland Plaza, Cincinnati, Ohio, Dec. 9-11, 1944. Approximately 300 members attended. Sixty-three individuals were elected to membership in the Society bringing the total membership to 1,089 as of Dec. 11, 1944.

The three-day program included the presentation of 80 papers on original research, which were presented in sections entitled: Fungicides, Virus and Bacterial Diseases, Disease Resistance, Seed and Soil Treatments, Factors Affecting Disease Development, and Fungus Diseases.

In addition to the presentation of research papers several conferences were held, including the conference concerning activities of the War Committee. The activities and accomplishments of this committee as developed through sub-committees and regional committees, and through co-operation with other agencies are so extensive that they have had some influence on most of the food, oil and fiber production of the United States and Allied Nations.

A conference on "New Developments in Fungicides" was of special interest to many including representatives of fungicide manufacturers.

At a conference on plant disease surveys it was definitely shown that the work of the Emergency Plant Disease Prevention Program has proved of great value to wartime American agriculture by increasing the effectiveness of plant disease control programs throughout the country. It was reported that a number of new and potentially destructive diseases have been discovered in the United States. These have been called to the attention of research and quarantine agencies so that they may be studied and watched as a necessary precaution against future losses.

Following presentation of papers dealing with "disease resistance" an informal discussion on "breeding for plant disease resistance" was held.

A conference on the phloem necrosis disease of elm was held to discuss the possibilities of checking the spread of this disease and to inform those interested of the present research program.

Current problems and recent developments in seed treatment research work were discussed during a panel discussion period.

The officers of the Society for 1945 include: Dr. H. B. Humphrey, Box 14, Cosmos Club, Washington, D. C., President; Dr. J. H. Craigie, Central Experiment Farm, Ottawa, Canada, Vice-President; Dr. E. M. Johnson, Agricultural Experiment Station, Lexington, Kentucky, Secretary; and Dr. R. M. Caldwell, Dept. Botany, Purdue University, Lafayette, Indiana, Treasurer.

*Tegucigalpa (Honduras):* **School of Pan American Agriculture** (*cf.* Pl. and Pl. Sci. in Lat. Am., p. xxi): — Announcement has been received that this school, founded and to be maintained by the United Fruit Company, is to be formally opened on Columbus Day, 1944. A provisional opening was made in September 1943, with an enrollment of 74 students selected from Mexico and six of the Central American countries. The opening of the school followed an authorization in 1942 by the National Congress of Honduras of a location within that country. A considerable tract of land was purchased at Zamorano, about 25 miles from Tegucigalpa, the national capital. Buildings are under construction to accommodate a student body which is expected to reach the scheduled maximum of 160 by the fall of 1944. A basically practical course of instruction is projected to run for 3 years, with a fourth year added for students showing proficiency and capacity for specialization. Four hours each day will be devoted to field work, and an equal number to study. No tuition fees are charged, and students are furnished lodging, clothing, board, books, and other necessary equipment without cost. The primary purpose is to supply practical agricultural leadership for the American Tropics.

The director of the school is Dr. Wilson Popenoe, formerly of the U. S. D. A. Bureau of Plant Industry. Other members of the faculty include Alfred F. Butler, head of the department of agronomy and soils; Dr. H. A. Von Wald, agricultural engineering; and E. A. Rivera, livestock.

*Harpenden (Herts., England):* **The Centenary of the Rothamsted Experimental Station** was celebrated in July 1943. In honour of this event many historical accounts have been published (Agric. History 16:161-183, etc.). — A special double issue of the (British) *Monthly Science News* (No. 24, July 1943) reports in a very informative way about the history and especially also about the present activities of the various departments at Rothamsted. Copies may be obtained free of charge from the British Council, 3, Hanover St., *London, W. 1, England.*

*U.S.A.:* **Foundation for the Study of Cycles:** — Workers in many branches of the plant sciences, especially plant geography and very particularly in pollen analysis ought to keep in touch with this organization, the director of which is Dr. EDWARD R. DEWEY, 400 West 118th Street, *New York City.* Its governing committee is international, with representatives of Science and Industry from Canada, Great Britain and the United States. The Director, Dr. DEWEY, had published a little brochure on Rhythmic Behaviour which is illuminating, and which he will doubtless be glad to send to any who are interested. (P. B. S.)

**Agricultural Research in Great Britain:** — A useful and informative report and directory of current research has been published under the above title (1943, pp. 100, 1/6, H. M. Stationery Office) by the *Committee of the Privy Council for the Organization and Development of Agricultural Research.* The first part of the report is concerned with the organization of agricultural research, the second and longest part reviews the investigations now in progress in great detail. Agronomic visitors to the United Kingdom, as well as organizers of research anywhere in the world, will find the above booklet useful and stimulating.

*U.S.A.:* **"Fighting Collectors":** — Botanical and Zoological collections of Harvard University are the richer because of the desire of men in uniform to be "naturalists-at-large." Both ELMER D. MERRILL, S.D. Hon. '36, Administrator of Botanical Collections, and Professor THOMAS BARBOUR, '06, S.D. Hon. '40, Director of the University Museum, record that specimens of flora and fauna have been sent to Harvard by soldiers and sailors from all over the globe. "It is interesting to note," Dr. MERRILL remarks in his annual report to the President, "that a number of individuals in military service stationed in the Southwest Pacific area are actually sending in botanical material for identification and report." Professor BARBOUR discusses throughout the accounting of his stewardship the birds from islands of the Southwest Pacific, mollusks from North Africa, and the insects from the East Indies gathered and forwarded to Cambridge by soldiers, sailors, and ambulance drivers. These contributions, he adds, have filled important gaps in the collections (*Harvard Alumni Bulletin*).

*Sweden:* **Methods and Objectives in Tree Breeding:** — In the course of surveys undertaken in Swedish forests to obtain basic information for tree-breeding work, it was found that natural selection within different tree species had produced definite species types, which differed widely from each other in certain characteristics, including increment. Thus, the "comb" Spruce has been found to be superior to Spruces of other branching habits in both height increment and diameter increment, while the wood of this type is equal to that of slower-growing types in density and in quality and output of sulphite pulp.

Since Spruces of different branching habit occur practically everywhere side by side under similar conditions and on the same type of soil, branching habit must in such cases be a genetically conditioned character. As all such species types are far from uniform in quality, varieties with coarse branches or other qualitatively inferior characters, genetically conditioned, must be rejected for breeding purposes. Elite trees of the "comb" type have been selected for cone collection and progeny tests, and some "comb" Spruce stands, apparently of great value, have been reserved as "live seed stores" from which the greatest possible quantity of seed can be collected in each seed year.

Disease resistance is an important factor to be considered in the selection of seed trees. Work of the Association for Forest Tree Breeding has included the testing for susceptibility to disease of Spruce seedlings raised from seed collected from apparently rot-free trees growing in severely infected stands in different parts of Sweden.

In Pine selection the aim has also been to obtain types representing high quality as well as high production capacity and special attention has been given to fine-branched types of the narrow-crowned Pine whose valuable characteristics have been defined by

Lindquist (1935-42). Steps have been taken to create a living seed store in specially suitable élite stands in the crown forests in Lule Lappmark and in Småland. A remarkably rapid rate of growth has been recorded from progeny tests in some of the stands in Småland.

Since Birch breeding began, superior specimens, as regards both yield and quality, have received attention, the valuable curly Birch (masurbjörk), the Grey Birch (gråbjörk) and the wavy-grained Birch (flambjörk) being of particular interest to the breeder. Many élite trees of these types and of White Birch (glasbjörk) and warty Birch( wartbjörk) have been selected as mother trees and some of the seedlings are already undergoing comparison trials in different parts of the country. A fairly large percentage of 5-year-old plants from seed of mother trees of pronounced curly-Birch type exhibited definite curly-Birch characteristics when only 3 years old. Races of disease-resistant Birch have been sought and tests at Ekebo of different mother trees have shown marked differences in the susceptibility of the various progenies to rust. The great variation in the susceptibility of Birch to rot suggests that resistant races could be bred.

Work with the Aspen (*Populus tremula*), including giant forms and economically valuable local diploid races, has provided a starting point for Aspen breeding which has already given results of considerable practical value, including the discovery in different latitudes in Sweden of races differing in photoperiodism.

Surveys and selection of superior types of Oak, Beech, Ash, Elm and Alder for breeding purposes have also been carried out and in particular a relatively large number of progeny of different Oak trees from various parts of the country are undergoing comparison production trials at places in Scania, Östergötland and Västmanland.

Investigations have been made on hardiness in Spruce, Oak, Beech, Ash and Aspen. The central European or "German" Spruce has proved specially productive in southern and central Sweden, but its lack of hardiness has prevented this strain from being grown further north. There is a wide range of variation for this characteristic and seedling selection during the recent severe winters, amplified by freezing-chamber tests made in the Association's laboratory, will, it is believed, give valuable practical results in the near future. Freezing experiments have also been used to demonstrate for Oak, Beech, Ash and other deciduous trees, a correlation between hardiness and earliness in autumn colouring and leaf shedding.

In addition to selection, both hybridization and chromosome alteration have also been used since the work at Ekebo started.

From work on Aspen crosses, carried out in a greenhouse with artificial lighting to induce flowering, about 600 different crosses between various parent trees have yielded large numbers of hybrid progenies which are now undergoing production trials in Scania, Småland, Värmland, Västerland, Dalarna, Angermanland and Västerbotten. From the growth and development of the young seedlings preliminary indications of the practical value of the various hybrid combinations has been obtained. The most promising hybrids have in recent years been multiplied for sale and planting out on a relatively large scale.

Long standing research on Poplars and Aspens at Ekebo has resulted *inter alia* in some hybrids of remarkably vigorous growth habit, *e.g.*, crosses between Silver Poplar and [European] Aspen, and a series of particularly promising *Populus tremuloides* and *P. tremula* crosses. Some Poplar crosses that have been repeated are also highly promising.

Owing to the very variable set obtained in Elm crosses at Ekebo when cut branches were used, bottle grafting was generally adopted in 1942. Hybrids between local races of Elm and also between different Elm species are now being reared.

Since 1940 bottle grafting has been used in hybridization in the breeding of Birch, Spruce, Pine and Larch and other trees. With Birch it has been particularly successful and a big supply of well developed dwarf trees is now available as mother trees for all conceivable hybrid combinations. Among the numerous Birch crosses made in the past two winters are some between different Grey Birches, between extremely pronounced curly Birch forms, between different Swedish élite Birches and also between such Swedish Birches and different high-chromosome North American species used as the female parents, or Japanese species, etc., as pollen parents.

Crosses have also been made with trees in the open, and at Ekebo Black Alders (klibbalar)* of good forest type have been successfully used as ♀ trees in crosses with other varieties and also with other species of Alder. Since 1941 crosses have also been made with standing trees of Pine and of Spruce. The technique used is briefly described. Hybridization of Larch and a number of other foreign coniferous species was also carried out in the open in 1941 and 1942. At Grensholm in Ostergötland and in the

* Klibbal (*Alnus glutinosa* Gärtn.) so defined in *Bull. Yale Univ. Sch. For.* No. 40. Swedish-English Vocabulary for Foresters.

Swedish Seed Association's (Sveriges Utsädesförening) grounds at Svalöf, crosses were made with selected mother trees of various Larch species and the seedlings are now being raised at Ekebo, as well as hybrids from different interspecific crosses of *Picea, Pinus, Abies, Pseudotsuga* and *Chamaecyparis,* one aim in this group being specially vigorous growth.

Following the recent discovery of giant Aspens with a much higher volume yield than the diploid, a tetraploid Aspen of a specially vigorous type with 76 (57 + 19) chromosomes has been produced. After the discovery of female giant Aspens, which made crosses of giant forms of different sexes also possible, further crossing experiments with Aspens of various types have resulted in a number of new tetraploid Aspens of value for further breeding operations. Results with colchicine treatment of seeds and the tips of growing shoots, which produced chromosome doubling in many plants, have also been applied recently at Ekebo to Aspen, Beech, Alder, Oak, Pine, Spruce and Larch, and results of practical value have been recorded, especially with Aspens and Birches.

To hasten the breeding process, research has been conducted on vegetative propagation, and new methods of propagating selected élite Aspens and other species by root cuttings have been tested successfully on a large scale.

Still more successful experiments with Birch have been made using layering and grafting, and Birch has also been propagated using shoots from stumps of felled trees. Thus no great difficulties should be encountered in the vegetative propagation of this species even on the scale needed in practical forestry; and similar possibilities appear to be within reach for other deciduous trees.

In view of the importance in breeding work of inducing flowering in young seedlings, experiments with the well-known method of strangulation or constriction with steel wire have been tried with young conifers and deciduous trees. The results in Spruce stands are looked forward to with interest, particularly as a means of increasing seed production to provide better facilities for regeneration in the difficult mountain forests.

The outcome of investigations on the induction of flowering by various methods in tetraploid Aspen seedlings is eagerly awaited, one of the ultimate aims being to obtain triploids from diploid × tetraploid crosses. From such triploids large numbers of other triploids could be obtained by vegetative propagation (M. L. C. W. *in For. Abstr.* after N. Sylvén *in Svenska SkogsvFören. Tidskr.* 41:40-78, 1943).

*U.S.A.:* **A Conference on Pollen Analysis and Related Bog Problems:** — An informal panel discussion on pollen analysis and related bog problems was held September 13, 1944 at the Cleveland meeting of the American Association for the Advancement of Science. The discussion was under the auspices of the Ecological Society of America. The personnel of the panel consisted of Drs. C. A. Arnold, Pierre Dansereau, John E. Potzger, and L. R. Wilson, chairman.

The discussion centered about methods of collecting and studying samples, identification problems, and the interpretation of results. Dr. Potzger discussed at some length the values of various graphs, and concluded that the bar type of graph drawn on coordinated paper seemed to be the most readily comprehended. The relation of pollen statistics to present ecological problems of forest distribution was discussed by Dr. Dansereau who pointed out a number of contributions that can be made by careful pollen studies of peats. In the absence of Dr. C. A. Arnold, the Tertiary pollen fossils were discussed by Dr. L. R. Wilson, who called attention to the fact that the brown coal deposits of North America contain an abundance of modern pollen forms whose study will aid in the understanding of modern forest history. A spirited discussion followed the presentation of problems.

Consideration was given to the advisability of organizing the pollen workers into a society. A vote decided that the group will continue as an informal body, and that the circular edited by Dr. Paul B. Sears of Oberlin College, Ohio, will be the vehicle for the exchange of ideas.

The success of the meeting is indicative of the great interest that lies in the science of fossil pollen and the promise of future contributions and meetings of its workers. (L. R. W.)

*China:* **Annual Conference of the Agricultural Association of China:** — The 25th annual conference of the Association, held in Chungking, closed on October 8, 1944. Three hundred and twenty-five members and guests attended the conference. Among the speakers were Minister of Agriculture and Forestry Shih-tsai Sheng and Minister

of Education LI-FU CHEN. Minister SHENG expressed the hope that more attention be paid to the reclamation of idle land, the improvement of peasant life, and the promotion of rural rehabilitation. He stressed that China can bring about sound industrial development only upon a sound agricultural foundation. Minister CHEN declared that the primary condition for promoting agriculture in agricultural China is the coordination of the nation's financial policy with its agricultural policy. He added that the banking concerns should be encouraged to invest their funds in farming enterprises, which occupy more than 85 percent of the country's population. Due to the absence of Mr. P. W. TSOU, Pres. of the Association who is now in the U. S. A., Mr. TIEN-HO CHIEN, well-known sericulturist and Vice-Minister of Agriculture and Forestry and Dir. of the Association, acted as chairman. Discussions centered around present and postwar measures for agricultural reconstruction and a program of coordination between agriculture, industry, and commerce. Twenty-two papers on scientific agriculture were read. The Association decided to send ten students to the U. S. A., all on American scholarships. They will include one student of soils, one of horticulture, one agricultural librarian, three students of sericulture, and four of veterinary medicine. The Association, with branch offices in Kunming, Chengtu, and America, now has 4,385 members. It has a sinking fund of Ch$1,000,000 and scholarship funds amounting to Ch$1,800,000.

**American Seeds in Russia:** — According to a press release issued by Russian War Relief, Inc., under date of May 5, 1944, more than 4,400,000 lb. of vegetable and field seeds have been shipped by that agency from the United States since January 1, 1943. More than 700,000 lb. of vegetable seed and 2,231,161 lb. of field seeds were direct gifts from American seedsmen, institutions, and farmers, and purchase of the remainder of the seed shipped was made possible by contributions to the National War Fund. Forty percent of the seed sown in the Moscow area was supplied from this source. What is considered a very high rate of purity and germination was noted. It is believed that work with these seeds by a number of experimental stations and individual experimenters in Russia will yield results of wide value. A report from ALEXANDER PEREVEZENTSEV, senior agronomist from the Moscow Soviet, states that "we presume that by means of crop breeding and selection we will succeed in obtaining new varieties. Undoubtedly the most valuable of them will in due course recross the ocean . . . ."

*England*: **The Nutrition Society** organized a symposium on *the Nutritional Rôle of the Microflora in the Alimentary Tract,* on Dec. 30, 1944. The following papers were read "Microbiological Aspect of Rumen Digestion" (A. C. THAYSEN, Chem. Research Lab., Dept. of Scientific and Industrial Research); "Formation of Protein" (J. A. B. SMITH, Hannah Dairy Research Institute); "Synthesis of Vitamins by Microorganisms of the Alimentary Tract" (S. K. KON, Nat. Institute for Research in Dairying); "Formation and Absorption of Volatile Acids in the Rumen" (A. T. PHILLIPSON, R. A. MARSHALL and S. R. ELSDEN, Unit of Animal Physiology, Cambridge); "Utilisation of Volatile Acids" (Sir JOSEPH BARCROFT, Unit of Animal Physiology, Cambridge).

**Refrigeration Research Foundation:** — This foundation is a nonpecuniary corporation, organized under Illinois laws on October 14, 1943. Its support is announced as from "voluntary subscriptions by any corporation, firm, or individual engaged in the preservation of food or other commodities by refrigeration." Its purposes are "(1) to improve the methods of refrigeration for the better preservation of food and other commodities essential to the health and welfare of the American people, (2) to develop and support research in the science and art of refrigeration of food and other commodities through a Nation-wide program of financial grants to established institutions and agencies of research, (3) to establish fellowships in institutions and agencies of research and thereby to aid in the training of competent personnel to give activation and leadership to the refrigeration of commodities essential to the national economy, (4) to establish in the interest of the American people a repository of scientific information relating to the refrigeration of food and other materials, (5) to cooperate with and aid agencies of Federal and State governments, institutions of research, and others in connection with their scientific and educational work involving the refrigeration of food and other products." A minimum requirement of $250,000 to initiate active work has been met, and a number of projects have been received.

The chairman of the board of governors is Dr. S. C. PRESCOTT, Cambridge, Mass. The president of the foundation is R. M. HAGEN of the California Consumers Corporation, and the director is H. C. DIEHL, Mercantile Building, Berkeley 3, Calif. Among

the members of the board representing the public are Dr. EUGENE C. AUCHTER, head of the U. S. D. A. Agricultural Research Administration, and Director W. A. SCHOENFELD of the Oregon Experiment Station. There is also a scientific advisory committee of 17 members, among whom are F. W. ALLEN of the California University and Station; Dr. C. O. BRATLEY, D. F. FISHER, and W. T. PENTZER of the U. S. Department of Agriculture; Dr. W. L. MALLMAN of the Michigan College and Station; and Dr. G. F. STEWART of the Iowa College and Station.

**War Botany or "Stratiobotanik":** — During the second part of the First World War the regretted Swiss botanist A. THELLUNG coined the word "Stratiobotanik." An interesting account about these special aspects of applied plant geography and ecology may be found in Festschr. Naturf. Ges. Zürich, Vierteljahrsschr. Naturf. Ges. Zürich 62:327/335 (1917). The following abstract (E. BAUMANN *in* Bot. Cbl. 140: 300/301, 1919) gives the essentials: —

THELLUNG unterscheidet drei Gebiete, auf denen sich der Einfluss des Krieges auf die Pflanzenwelt geltend macht:

I. Der zerstörende Einfluss des Krieges auf die Natur-, Halbkultur- und Vollkulturformationen. Durch Anlegung von Schützengraben, Explosion von Minen und Einschlagen der Geschosse wird das Erdreich aufgewühlt, die Vegetationsdecke zerstört und prächtiger Wald ruiniert. Ein spezifisches Kriegsphänomen ist die schädigende Wirkung der beim Platzen von Geschossen oder in anderer Weise verwendeten, giftigen Gase auf gewisse Pflanzenarten. In Lothringen wurde ein eigenartiges Absterbensphänomen von *Picea excelsa* beobachtet; in der Champagne bedingten chlorhaltige Gaswolken eine intensive Rotfärbung von *Pinus silvestris* und eine Schädigung vieler anderer Pflanzen.

H. Der Krieg ruft die Bildung neuer Nebenkulturformationem mit z. T. charakteristischer Flora hervor. Nach Beobachtungen vom deutsch-französischen Kriegsschaup atz dominieren im Frühjahr um Stacheldrahtverhaue *Papaver Rhoeas*, im Spätsommer in Schützengraben *Stachys annuus*. Die Pflanzen wurden z.T. durch die Truppen selbst verschleppt (Kleider, Heu, Stroh), ferner zu allen Zeiten durch den Proviant- und Fouragetransport und siedeln sich an Truppenlagerstellen an. Das grossartigste Beispiel dieser Art bietet die von GAUDEFROY und MOUILLEFARINE publizierte Belagerungsflora (Flora obsidionalis) von Paris 1870/71 mit vorwiegend mediterraner, wohl durch algerisches Pferdefutter eingeschleppter Vegetation (190 Arten!).

Auch in neutralen Ländern zeigt sich statt der "Kampffrontflora" eine "Grenzbesetzungsflora." In Délémont (Schweizer Jura) erschienen an Plätzen früherer Stroh- und Heumagazine schweizerischer Truppen ca 30 meist fremde Arten, von denen sich *Salvia verticillata* dauernd eingebürgert hat. Von Schwyz wurde 1915 eine "Pferdemusterungsflorula" erwähnt. Von besonderem Interesse ist die Einschleppung indischer Fremdpflanzen durch indische Hilfstruppen 1915 bei Marseille, darunter drei fast ganz auf das ostindische Florengebiet beschränkte und für Europa neue Arten (*Andropogon caricosus* ssp. *mollicomus, Themeda quadrivalvis* und *Myriactis javanica*).

III. Der Einfluss der durch den Krieg veränderten wirtschaftlichen Verhältnisse macht sich sowohl durch Lahmlegung oder aber Wiederaufleben der Industrie und Technik geltend. Eine tief umgestaltende Wirkung übt der Krieg auf die Kulturformationen aus. Auch in den neutralen Ländern werden die Vollkulturformationen (Gemüse- und Ackerland) auf Kosten der Nebenkulturformationen (Oedland) vermehrt; vergessene und heute verschmähte Nutz- oder Gewürzpflanzen werden jetzt wieder gesammelt oder in Kultur genommen.

*Tucson (Ariz., U.S.A.):* **The Herbarium of the University of Arizona** is acquiring the private herbarium of Dr. FORREST SHREVE of the Carnegie Institution of Washington. The Shreve collection contains 30,000 specimens and is recognized as containing an excellent representation of the Mexican flora. About half of the specimens are from Mexico and mainly from the northern half of that country. The other half of the collection is mainly from the southwestern states with about 1,500 sheets from Maryland, Georgia, and Alabama, and an undetermined number from Jamaica. The Mexican plants include a considerable number of old collections made by PRINGLE, PALMER, MARCUS JONES, and PURPUS. The more recent material includes sets of nearly all of the important collections that have been made in Mexico since 1930. Included among the specimens are nine types, about 200 topotypes, and about 300 isotypes.

## News from Russia:* —

**The Work of Soviet Botanists.** (Radio address by SERGEI PILIPCHUK, transmitted by HARRY GRUNDFEST—the Russian and other editors and collaborators of the CHRONICA are not responsible for any statement in the following account). — The war, demanding a tremendous concentration of the forces of the whole people of the U.S.S.R., has also put forward a number of problems to be solved by the botanists. First and foremost, the huge expenditure of bandaging materials made it necessary for us to search for other than the raw materials ordinarily used for this purpose. In Russia and in a number of other countries during the World War of 1914/18, *Sphagnum* (peat bog moss) was used for this purpose.

At the very beginning of this war, work on the study and preparation of *Sphagnum* was begun by the Institute of Botany of the Academy of Sciences of the U.S.S.R. situated in Leningrad. Large quantities of *Sphagnum* were easily available in numerous peat bogs in the Leningrad district. *Sphagnum,* thanks to the peculiar structure of its cells, has excellent absorbent qualities. The moss is carefully cleaned of all extraneous matter, dried, steam sterilized and made into gauze-covered pads of various sizes.

Experience has shown that wounds heal much more quickly with *Sphagnum* bandages than with cotton-batting bandages. This is explained by the fact that, in addition to its draining qualities, the moss also contains certain disinfecting substances.

Under the guidance of botanists, large quantities of *Sphagnum* bandages were prepared for the Leningrad front, and a short pamphlet on the gathering and preparation of moss was printed. *Sphagnum* is now prepared on a large scale in the northern regions of the Soviet Union.

Another item of interest to botanists was the preparation of fir balsam from the sap of fir trees. This balsam, mixed with other substances, has been used in many Leningrad hospitals for treatment of fresh wounds. The demand for this balsam is increasing rapidly as doctors are becoming acquainted with its use and its qualities. The number of fir trees in Siberia and the northern regions of European Russia is enormous and fir balsam can be prepared in unlimited quantities.

The search for vitamin-bearing plants has also given botanists a large amount of wartime work. One of the most important is vitamin C. Even before the war it was known that one of the richest sources of vitamin C is the wild rose hip. Since the war, vitamin contents of hips in the eastern and northern districts of the U.S.S.R. have been studied to discover where the vitamin content is greatest. In some places wild roses have been planted in order to produce hips rich in vitamin. The collection and delivery of hips has been organized on a large scale. Hips of certain roses of Central Asia have been found particularly rich in vitamins and these sorts are being specially cultivated.

It has recently been discovered that green unripe walnuts growing in dense forests in Central Asia also contain vitamin C. Collection of these nuts and manufacture of vitamin-bearing preparations have been organized.

Quite recently it was discovered that needles of ordinary pine trees contain large quantities of vitamin C. Biochemists in Moscow and Leningrad have organized mass production of vitamin C concentrate from pine needles. Despite the fact that the percentage of vitamin contained in needles is very small, this source of vitamin C is of particular value to us on account of the huge pine forests throughout the whole territory of the Soviet Union with the exception of the Arctic and desert regions.

During the long siege of Leningrad lack of vitamin C made itself particularly felt, and the decoction made from pine needles played an important role in the prevention of scurvy. In its impure state the liquid has a bitter flavor, but a number of proposals have already been made for freeing the liquid of its bitterness. Since the war began, a number of grasses have also been discovered to contain vitamin C.

Botanists have taken an active part in gathering wild medicinal plants; in cultivation of plants for the manufacture of insecticides; and in the discovery of new plants which might be used medicinally.

Attention has also been paid to a number of wild plants which can be used as salads, for example, the dandelion, primrose, etc. Attention has also been devoted to the roots of other plants rich in starch and inulin, and to fruits of a number of wild trees and shrubs such as bird cherry, hawthorn and rowan. A flour is produced from dried rowan berries which may be added to ordinary flour in proportion up to 25 per cent. and used for baking pastry, etc. Flour made from bird cherries gave excellent results in cakes. These are all results of work done by botanists to help the inhabitants of Leningrad during the siege of last winter.

Much has also been done to find substitutes for tea and coffee from wild-growing flowers. One item of particular interest is the publication of an illustrated pamphlet for guerillas and raiding troops operating behind enemy lines, giving details of all wild-growing edible plants. (B. SHISHKIN).

**Agricultural Developments in the U.S.S.R.** (by our Associate Sir JOHN RUSSELL, F.R.S., reprinted with kind permission of the Editor, *from* Nature 152:525/526, 1943). -- Prior to the Revolution three systems of farming were practised in the U.S.S.R.: (*1*) large estates; (*2*) small peasant farms; (*3*) peasant land farmed by the peasants under the *Mir,* the village council or commune of very ancient origin.

Some of the large estates were run on good modern lines, some were put into the hands of managers whose business it was to extract all they could for the owner, others were moderately well managed. The peasant farms were small holdings owned by the individual farmers, which had resulted from the various agrarian reforms, the most important of the later ones being those of STOLYPIN (1905), who had a Danish adviser and was aiming at the Danish model. The peasant land under the commune (*nadiel* land) belonged to the body of peasants but not to any individuals;

* The fourth of a series of accounts on recent progress and current work in our field in the U.S.S.R.; *cf.* CHRON. 7, 7:336, 1943, *et ante.*

it was parcelled out into many strips which were periodically distributed by the *Mir* among the peasants in accordance with the size of family, etc. These strips were scattered over the whole area so that each man should have his share of good and of bad soil. In the time of the Revolution it was estimated that about 45 per cent of the cultivated land was in the hands of the peasants.

All three systems were disliked by the Bolsheviks, the first two because they involved private ownership of land, and the third because of its grave inefficiency and the utter impossibility of introducing modern improvements. The Bolsheviks also disliked the peasant mentality, so utterly different from that of the factory worker. The peasant wanted to sell his products at high prices while the factory worker wanted to buy them cheaply. The factory worker was accustomed to work in masses for an employer, and had before the Revolution no sense of proprietorship: the peasant was used to working alone or in small groups and always felt that he owned the land he tilled.

After some experiments, State farms were set up which accorded well with Bolshevik theory. The peasants were employees of the State receiving a weekly wage, living in great blocks of dwellings in a central area developed like a town. The whole organization resembled that of a factory, and it was expected that the peasants would develop the factory workers' outlook and become one with them. But the peasants did not like them and so they never developed: in 1938 only about 10 per cent of the cultivated land was worked as State farms, and they were used for special purposes. A completely different type of farm was set up, on the basis of the old *Mir*. The first were communes in which the whole body of workers was responsible for the full maintenance of each individual family; but this did not answer. The *artel* organization was therefore adopted: another old Russian method which has no English equivalent. In this the workers feed and house themselves but the produce belongs to them, and after all outgoings have been met the balance is distributed according to the work done. The workers are paid in actual produce: mostly grain, potatoes, and vegetables, these being the main constituents of the peasants' dietary; usually also there is hay for the workers' animals, and a small amount of cash. This method after suitable modification proved much more acceptable, and by 1939 a very large part of the cultivated land of the U.S.S.R. was farmed in this way.

The farms were called 'Collectives.' All the cultivated land in the village, whatever its previous ownership, was thrown into one big farm: it might be 1,000-4,000 acres or more, but was not usually unmanageable in size. All the peasants of the village could come into the group, but preference was given to the so-called 'poor peasants'. The plan of production was until just before the War sent from headquarters: it had been discussed during its development, but once settled, it could not be further discussed. The workers elected a committee to carry it out and to allocate the tasks to the different people; the chairman, however, was not freely elected as he had to be accepted by the Party and the Government; he often came from outside and did not usually stay long. The Party always insisted on keeping its hold on the farms, and it had its representative, who was quite independent of the committee.

Payment was always by the piece; a certain job of work was called a 'labour day', and when a man had done this he was credited with one day's work. Not infrequently about two hundred would be done during the year, but specially good workers would put in many more. The worker could eat his share of the produce or sell it to the farm, the Co-operative or in the peasant market.

The workers' share of the produce varied with the yields and the outgoings. The Government's share has varied. For some time prior to 1939 it was a fixed amount per acre of winter grain sown, and of spring grain ordered to be sown, also a fixed quantity of milk and meat per animal kept. A small price was paid, much below the market price. In 1939 more latitude in planning was allowed so long as the stipulated Government share was duly delivered. As this was fixed while yields were variable it is impossible to state any definite percentage; but an average of a number would lie between 15 to 20 per cent. Then the machine tractor station, the Government organization that hired out the tractors, combines and other big tackle and supplied the drivers, had to be paid: this might take another 15 per cent. Seed for next season and fodder for winter had to be set aside: this also might amount to about 15 per cent. Insurance, administration, sick and needy people, maintenance, capital developments, and other farm overheads had also to be provided for. One way and another, more than half the produce would go, and the workers' share might be 40 per cent or less.

A great change in the system, and in the peasants attitude to it, came when the Constitution of 1936 gave the collective farms the use of their land for ever, and also gave each member the use of his cottage and its garden and a holding varying from ½ acre to 2½ acres on which he could keep such animals as he and his family could look after. So popular were these holdings that by 1939 much of the peasants' time was spent on them and a large proportion of the livestock of the U.S.S.R. was their private property. So decrees went forth that they must put in a minimum of a hundred days per annum on the farm; this number has since been raised.

There is little doubt that when peace returns this modified system will be able to provide the U.S.S.R. with the food needed for a rising standard of life. The theoretical objection still remains: the peasants are not employees and do not come under the labour code: they have, for example, no trade union and are ineligible for old-age pensions. 'Peasant-mindedness' still continues and they are not one class with the factory workers. But so many theoretical difficulties have been brushed aside in the U.S.S.R. for a realistic solution that we may expect this also will disappear and the system will become wholly acceptable.

**U. S. Botanists in Peru:** — Survey groups, each made up of a botanist and a forester have been working for the Foreign Economic Administration in Peru for about a year and a half and at the present moment are disbanding, their work completed.

The primary purpose of these surveys was to search out all accessible stands of wild cinchona trees; to take bark samples of these for analyses, as well as herbarium

# MORE ONIONS

*by*

**THOMAS HAY, C.V.O., V.M.H., Ex-Superintendent, Royal Parks**

*GERARD* in his Herbal, written in 1597, tells us that "the onion requireth a fat ground, well digged and dunged," and this is just as true in 1943. He tells us further that "the juice of the onion anointed on a balde head bringeth again the haire speedily." The veteran herbalist may have given this hint to those who had some worry over the onion crop.

If the soil is poor, thin or gravelly, it will require the very best you can give it to ensure success, so dig in the best of the compost heap if no farmyard manure is to be obtained and, failing both, any material that will retain moisture such as spent hops or moss litter. This will help. Failure is often most experienced on soils that dry out quickly, so mulching and plenty of water will be of great assistance. If no humus-making material is to be had, a good general fertilizer must be applied before sowing or planting. On such soils success is more likely from plants raised under glass in early spring than from a direct sowing in the open. It is advisable, however, to try both planting and sowing.

*SOWING* should be done in March or early April, but only if the soil is in the right condition for sowing. It should be just in that state when one can tread it firmly without it sticking to boots or tools. Draw the drills 1 ft. apart and a good inch deep. One ounce of seed will sow the eight rows recommended on the Ministry of Agriculture's plan, and if germination is satisfactory, they must be thinned out carefully—the thinning out to begin when the young onions are fit for use, leaving the finest plants 5 or 6 inches apart in the rows.

*WHEN* planting the glass-grown onions, see that they are stout and healthy and have not been subjected to too much heat, and above all that they have been well hardened off. Plant the roots only, leaving the small bulb on the surface. Use a trowel so that the root can be spread out a little and not packed tight as when a dibber is used. Don't worry if the young plants don't stand upright; they will do so a few days after planting.

*WHEN* the bulbs have fully matured and the foliage shows signs of ripening, they are lifted, dried in the sun and stored away from frost. I saw the other day a basket of magnificent onions, plump, fresh and solid. They had remained in the soil all winter. I was informed that the grower had no shed in which vegetables could be stored, only a small larder, so he left the onions in the ground during the winter, well covered with loose bracken. My informant added, "If I had to grow onions for sale, this is how I'd store them. They weigh out so much better."

*Expert Advice Series No.* 8 PLANT PROTECTION LTD. YALDING KENT

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specimens; and to estimate the bark volume with the idea of immediate exploitation. The whole South American cinchona program* was an emergency one forced upon the United States by the capture of Java with the subsequent elimination of 95% of the

* *Cf.* this CHRON. pp. 119 and 121.

world's quinine. The bark supplies discovered in Peru, though extensive, have been for the most part lowgrade, although to be purchasable they have had to contain a minimum of 3% of crystallizable alkaloids. Our biggest task has been to control the "cascarilleros," or bark cutters, who in many new areas did not know the differences between good and bad grades of bark. And as far as that goes botanists too can be as bad as the cascarilleros, for forms of "cascarilla" in one area may contain the requisite amount of alkaloids but in another area the identical form may be worthless! For this reason the taking of carefully dried bark samples and their subsequent test analyses was always final proof whether a given stand of trees was exploitable or not.

Peruvian cinchona barks fall into two principal categories: *1*) quinine barks — naturally the more valuable, and *2*) cinchonine barks. The main proportion of Peru's production during our period of work has been in cinchonine bark, although important quantities of quinine bark of the famed "calisaya" type still come regularly from the Tambopata Valley which lies next to the Bolivian frontier. In recent years the production of cinchona bark has averaged about 50 tons annually; our program has boosted this to a 3-year average of over 400 tons annually.

Needless to say, we cinchona hunters have gotten to know the Andean country intimately for we have scoured all the accessible as well as many an inaccessible part of the continuous cinchona belt which lies principally in the eastern Andes between elevations of 2,000 to 10,000 feet. In Peru we have travelled into this belt by plane, automobile, mule, and foot . . . from Ecuador to Bolivia . . . and in this zone of unrivalled beauty we have been able (unlike any other cinchona hunter of the past) to see and to collect representatives of the majority of the species and varieties of the genus, *Cinchona*, as found in Peru. The careful study of this collection along with those made by cinchona hunters in the other Andean countries should clear up once and for all the mess in which this complex genus has up to now found itself. — W. H. HODGE (*cf.* also Journal N. Y. Bot. Garden, Feb. 1944).

**A revised and new list of Botanical and Agricultural Institutions in Turkey** (*cf.* CHRON. 4:359, 1938): —

ADANA:
**Ziraat Mücadele Istasyonu (Plant Protection Station).** — Dir.: HAYDAR IRTEL.
**Pamuk deneme, islah ve üretme çiftligi (Cotton Breeding and Experiment Station.**

ADAPAZARI:
**Tohum islah ve deneme istasyonu (Seed Production and Experiment Station).**

ANKARA:
**Yüksek Ziraat Enstitüleri (College of Agriculture):—**
- **Nebat yetistirme ve islâhi enstitüsü (Agronomical Institute).** — Dir.: Prof. VAMUK TAYSI.
- **Nebatat enstitüsü (Botanical Institute).** — Dir.: Prof. HIKMET BIRAND.
- **Bahçivanlik, Meyvecilik ve Bagcilik Enstitüsü (Horticultural, Pomological and Viticultural Institute).** — Dir.: Dr. NAIL ORAMAN.

**Merkez Ziraat Mücadele Enstitüsü (Central Institute of Plant Protection).** — Dir.: HILMI GÜNGÖRÜR.
- **Fitopatoloji Şubesi (Department of Phytopathology).** — Chief: Dr. SELAHATTIN KUNTAY.
- **Entomoloji Şubesi (Dept. of Entomology).** — Chief: Dr. BEKIR ALKAN.

**Tohum islah ve deneme istasyonu (Seed Production and Experiment Station).**

ANTALYA:
**Sicka iklim ziraati deneme istasyonu (Experiment Station for Tropical Crops).**
**Narenciye Istasyonu (Citrus Station).**

ANTEP:
**Fistik Istasyonu (Pistachio Experiment Station).**

ARIFIYE:
**Elma Istasyonu (Apple Experiment Station).**

AYDIN-ERBEYLI:
**Incir Istasyonu (Fig Experiment Station).**

ERZURUM:
**Tohum islah ve deneme istasyonu (Seed Production and Experiment Station).**

ESKIŞEHIR:
**Tohum islah ve deneme istasyonu (Seed Production and Experiment Station).**
**Dryfarming deneme istasyonu (Dryfarming Research Station).**

GIRESUN:
**Findik Istasyonu (Hazelnut Experiment Station).**

GÜMÜŞHANE:
**Kenevir Istasyonu (Hemp Experiment Station).**

ISTANBUL:
**Istanbul Üniversitesi, Fen Fakültesi (Dept. of Sciences of the University):** —
**Umumi Nebatat Enstitüsü (Institute of General Botany).** — Dir.: Prof. L. Brauner.
**Ispençiyâri Nebatat ve Genetik Enstitüsü (Inst. of Pharmacognosy and Genetics).** — Dir.: Prof. A. Heilbronn.

ISTANBULE-BÜYÜKDERE:
**Yüksek Ziraat Enstitüleri, Orman Fakültesi (College of Agriculture, Department of Silviculture):** —
**Silvikültür Enstitüsü (Inst. of Silviculture).**
**Orman Muhafazasi Enst. (Inst. of Forest Protection).**

ISTANBUL-MALTEPE:
**Inhisarlar Tütün Enst. (Tobacco Research Institute of the Government Tobacco Monopoly).**

ISTANBUL-RUMELI HISAR:
**Dept. of Biology and Herbarium of Robert College.**

ISTANBUL-YEŞILKÖY:
**Tohum islah ve deneme istasyonu (Seed Production and Experiment Station).**

IZMIR-BORNOVA:
**Ziraat Mücadele Istasyonu (Plant Protection Station).** – Dir.: Nihat Iyriboz.
**Bagcilik Istasyonu (Viticultural Experiment Station).**
**Zeytincilik Istasyonu (Olive Experiment Station).**

KAYSERI:
**Yonca Istasyonu (Alfalfa Experiment Station).**

MALATYA:
**Kaysi Istasyonu (Apricot Experiment Station).**
**Pamuk deneme, islah ve üretme çiftligi (Cotton Breeding and Experiment Station).**

NAZILLI:
**Pamuk deneme, islah ve üretme çiftligi (Cotton Breeding and Experiment Station).**

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**Türk Fizik ve Tabii Ilimler Sosietesi (Turkish Society of Physical and Natural Sciences). — Istanbul-Yesilköy.**

*Istanbul (Turkey)*: **University Botanic Gardens:** — A correspondent of *the Gardener's Chronicle* reports on recent developments. The Curator is Mr. G. Catt, formerly of Kew and the London Film Production Gardens. His appointment was made through the medium of the British Council in Jan., 1941. He is responsible for organizing all practical work in connection with the gardens, for training gardeners and apprentices, and preparing plants and specimens for the lectures at the University. The Gardens are situated on the site of the old Muftuluk Gardens to the north of the Suleymanye Mosque and half a mile from the main University buildings. The Gardens are 4.2 acres in extent and are bounded by a high wall which supports the garden on the west, north-west and north-east sides. The site has a general slope to the north and all the developed portions have had to be terraced. The general design of the garden serves to illustrate clearly the development of plant life from primitive forms. The Biological Institute is situated in the gardens. It is a large, modern, concrete building. Mr. Catt has many plans for improving the Gardens, especially as regards the provision of more and better glasshouse space. The collection of tropical and sub-tropical plants, which includes a fair number of Bromeliads, Eucalypti, Cacti and Succulents, is somewhat limited and retarded in growth by the facilities available. The plant collection has been considerably augmented during the past years by means of seeds introduced from other countries, and space has been made for these by reducing the numbers of any one species grown inside to five small or two large plants. Mr. Catt plans to increase the number of economic plants grown, and also to have a greater variety of decorative subjects as the borders given over to this phase of horticulture are at present very small and narrow. He also hopes to make some preliminary tests for lawn grasses since the upkeep of lawns in Turkey is a serious difficulty. Plans for the provision of a permanent and sheltered nursery space, with seed beds, frames and ash-beds under controlled shade provided by a roof of slats or Bamboo, are already being put into practice. Many new species and varieties of plants have been introduced to the garden recently.

**A Survey of the Timbers of Tropical Africa:** — In the Emp. For. J. 22:32/36 (1943) Dr. B. J. Rendle (a son of the late Dr. A. B. Rendle of the British Museum) outlines a method of making a survey and of assembling information about the principal groups of timber of Tropical Africa. The main object of the proposed survey is to prepare a critical summary of practical information on the timbers of tropical Africa that would afford an essential background for the development of the Empire's timber resources. The author discusses the timber situation in tropical Africa with reference to the prewar importation of softwood saw timber from Scandinavia and North America, and the possibilities of increasing the use of secondary native timbers for local purposes and, to a limited extent, for export. A useful preliminary step towards the intensive exploitation of these species would be to classify them into broad groups according to their potential uses, having in mind the general purposes for which most of the timber is required locally.

*New York (N.Y., U.S.A.):* **The New York Botanical Garden** celebrated its fiftieth anniversary this year, the occasion was inaugurated with a Garden Week that began May 14, 1945.—The hurricane which reached New York the evening of Sept. 14, 1944, caused the loss of 135 large trees at the New York Botanical Garden, besides 50 or 60 saplings. Among them were some of the oldest and largest trees on the grounds, several specimens measuring up to four feet in diameter and 100 feet in height. Oak trees suffered the greatest damage. Hickory, hemlock, ash, and maple trees also were lost in large numbers, the majority of them native trees which had been on the grounds since before the existence of the Garden. Except for a few which were snapped off, they were mostly uprooted, and many of them showed a very shallow rooting system, spread out thinly over the rocks which dominate this area. In the arboretum there was also considerable damage, about 100 trees being affected, but there the majority of the specimens could be straightened or pruned, and repairs on most of them have been completed already. Only about a dozen were completely uprooted (these included three Colorado blue spruces near the conservatories), and the majority of these were not rare specimens. The work of removing and cutting the fallen trees, it is estimated, will continue steadily until spring. As many as possible of the large sound trunks will be utilized for lumber. Other wood felled by the hurricane will be used for burning in the furnaces. — A "Catalogue of Hardy Trees and Shrubs" of the Garden has been issued some time ago (127 pp., listing nearly 3000 woody plants in cultivation, $0.75).

*Brooklyn (N.Y., U.S.A.):* **The Brooklyn Botanic Garden** was directly in the path of the recent September hurricane, and its loss of trees and shrubs was extensive. Seventy-five large trees and about 150 small trees are down, and some 200 others need straightening. The damage was greater than in the hurricane of 1938. Many valuable specimens that cannot be replaced, including many trees that had been growing for 25 years or more, were destroyed. Two large Golden Larches were blown down. The only remaining *Toona* is gone — another *Toona* was killed by the severe cold of 1942-43. Among the losses were a large *Oleaster;* a tulip tree planted more than 30 years ago; and an Oriental plane tree believed to be the only one in the vicinity.

*Sweden:* **The Swedish Horticultural Research Service:** — In Sveriges Pomol. Fören. Årsskr. 42:5-16 (1941) F. Nilsson presents an account of the establishment of the State Hort. Res. Inst. at Alnarp following a decision by the Riksdag in 1937 that a special State institution for research work in horticulture should be set up in Sweden. In addition to the Institute at Alnarp, 3 large sub-stations have been erected, and a number of smaller sub-stations have been planned. As early as 1937 expts. were begun at Alnarp with material which had been arranged beforehand by Professor C. G. Dahl and which it was possible to plant out before the State Expt. Service had officially begun its work. A varietal and rootstock expt. with apples was initiated in which were included 6 vars. which were tested on 9 rootstocks, the majority of which consisted of East Malling types with 2 rootstocks selected at Alnarp. Further a cultivation expt. with different kinds of fruit trees was planted, also pruning and manurial expts. with apple trees and a varietal expt. with raspberries. Since then a new varietal and rootstock expt. with apples has been planted and also a similar expt. with pears, in addition to which varietal expts. with raspberries, black currants and strawberries have been initiated. In the meantime many new vars. have been bred and have been the subject of observation and in certain cases multiplication for more exact tests as to cultivation value. Expts. in planting, spraying and storing have been conducted. In addition, extensive plant breeding work is being conducted with apples, pears and plums. A brief account is given of the work at the sub-stations at Nyckelby, Rånna (here *inter alia* a rootstock expt. with cherries is to be planted at an early date including 10 vars. of cherries on 2 different rootstocks from East Malling), Söråker, Dingle and Ekerum. Trials are also in progress on all kinds of annual vegetables. The most important hitherto have been varietal and strain trials. During 1941 a series of seed production expts. was begun in east Scania, on Öland and Gotland. Their object is to ascertain the prerequisites for indigenous seed production of a number of vegetables — carrot, onion, white cabbage, brussels sprouts, parsley, cucumber, and radish — Sweden's seed requirements of which have hitherto been to a very large extent imported. Finally plans

*(Courtesy Hort. Absts.)*

*Pehpei (near Chungking, China)*: **A Research Institute of Botany** has been established by the Academia Sinica. Dr. CHEN-LOH LU, known for his work on plant physiology, has been named head of the institute. With his staff, Dr. LU will make an extensive study of the nutrition and metabolism of plants and a survey of fungi. His research will also include preservation of horticultural products.

*St. Andrews (Scotland)*: **Bombing of the Botanic Garden** (J. W. MOWAT of the Botanic Gardens, Univ. of St. Andrews, *in* Parks and Recreation 25, 7, March 1942; *cf.* also CHRON. 7, 7:347): — Needless to say, these things couldn't happen without serious damage to the [St. Andrews] Gardens and their contents. Our glasshouses are in two groups—one main group at the southeast corner of the Gardens and another extensive group away to the west side. The main group of glass at the southeast corner was right in line of the falling bombs and sandwiched between the two just outside and the two inside the grounds, with the result that the spectacle that greeted us when day broke was of tattered and sorry-looking tropical plants here and there poking their heads through a skeleton framework of twisted and broken astragals, and on the floors a knee-deep litter of smashed plants and pots, soil and glass in one glorious confusion. It turned out that the houses at the west side of the Gardens were in no better state though I had hoped that they might have escaped the full effects of the blast, being behind a high dividing wall and somewhat further from the explosions. The action of the blast seems unpredictable—in two houses in this group the framework was torn from the brick foundations. Most members of the garden staff were on duty with me throughout the night as members of the fire-fighting service and while we stood by all night I made arrangements with them to set about the rescue of all plants of possible value as soon as daybreak came. Fortunately, in addition to the Botanic Gardens we have several other gardens connected with college buildings in various parts of the city and in two of these were tomato houses which had suffered no damage and whose crop was nearly over. I told the foreman in charge of these houses to start his men clearing everything out of them right away to make room for the reception of the Botanic Garden collection and then to be ready to help in its transport. The Botanic Garden foreman was to hire anything on wheels that would carry plants and start to disentangle all plants or remains with a chance of life and gather them together for removal to the other side of the city. The work was in full swing by 9 a.m. and tropical plants were being moved across town in lorries, horse-cabs, and even in hand-carts. This went on till 6 in the evening, when we had most of the tropical plants that were movable and the more valuable fragments under cover again in their temporary quarters so, having been on duty all the previous night, we decided we would call it a day and get an overdue rest. The fates willed differently, however; an hour later the siren went and we were out on duty again, though this time there were no incidents and our "dismiss" came at about 3 o'clock on Sunday morning. — It was some days before we were able to turn our attention to the Gardens themselves. Here the destruction was more apparent than real—all the lawns were covered with a layer of black mud a foot or two thick near the scenes of the explosions and tapering off to a thickness of two or three inches in the further parts. Except for the old pear tree and, near the actual explosions, a number of shrubs and herbaceous plants which were practically disintegrated, the plants as a whole in the Garden suffered little damage and once the lawns had been scraped and then well washed by winter rains things did not look bad at all in the spring and during the summer most of the place has been got back to normal. A visitor now would find it very hard to believe that little more than a year ago we were without a pane of glass and our plants were lacerated by splinters and chilled by cold. The glasshouses were all quickly repaired and the losses in pot plants which were considerable in spite of all our efforts to get them under cover again at once, have been replaced as far as possible. The department buildings, too, have been completely repaired and are daily in full use again. — The whole incident, in spite of serious damage done, was not without its interesting features. The loss of all the glass in the greenhouses naturally caused a great disturbance in the lives of the tropical plants, particularly those which, being planted in beds or borders could not be transferred to other quarters for the time being. During the fortnight or three weeks that these plants were left exposed to all weathers they suffered three nights of frost, the lowest temperature being 29° F. One would have thought this meant the end of plants used to a minimum night temperature of 65° F. but in actual fact although many died others suffered no harm at all. — The only variety of *Hibiscus rosa-sinensis* to suffer even loss of leaf was the Double Yellow, but *Hibiscus schizopetalus* was cut back right to the main stems where it ultimately broke out again and made a good recovery. *Ficus elastica* and *repens, Murraya exotica, Monstera deliciosa, Piper nigrum, Triphasia aurantiola,* and even *Mimosa spegazzinii* did not lose a leaf while *Acacia sphaerocephala* lost its leaves only to break out all over in new growth to give a better looking plant than we've had for years. *Brunfelsia, Rondeletia odorata,* and *Tabernaemontana* lost their leaves but suffered no further damage. *Bignonia ornata, Cerbera, Hamelia patens, Lankesteria, Quisqualis, Terminalia,* and *Whitfieldia* were cut back severely but have made good recoveries. *Musa cavendishii* and *Sargania cuspidata* died back entirely but ultimately sent up root suckers again. *Anemopaegma, Clusia,* Clerodendron calamitosum, Guaiacum, Ixora, *Kopsea, Leea coccinea, Desmodium incanum, Norantea, Pogostemon, Theobroma* and *Vanilla* were killed out entirely. It is difficult to see in the foregoing lists any clue to what happened. Fleshy plants such as *Piper nigrum* from Malaya and *Monstera deliciosa* from tropic America were unharmed while *Clerodendron* and *Kopsea* from Malaya and *Norantea* and *Theobroma* from tropic America were killed. Striking, too, were the different responses of the various species of *Hibiscus* growing side by side. As a happy ending, some of these plants that survived have flowered for the first time since their establishment here thirty or more years ago.

*England*: **Kew and the War**: — The following extracts from a popular article in the Ill. Lond. News of Dec. 30, 1944 may be of interest: — In war, as in peace, the work of the Royal Botanic Gardens, Kew, goes on. Kew is the clearing-house for the botanic information received there from all quarters of the world, which it collects, reviews, assesses, and redistributes. In wartime, the sources of information shrink, and the dissemination of Kew's evaluation shrinks with them, but

the help that can be given and exchanged with our allies, and more especially with the Dominions and Dependencies of the British Commonwealth, cannot be neglected, and receives the personal administration by its directors. The visits that the late Director, Sir ARTHUR HILL, paid in supervision of them have been carried on, though on a necessarily curtailed scale.

This, as part of Kew's preoccupation in Economic Botany, is exemplified in Sir GEOFFREY EVANS' recent mission to Africa. It had, among other things, to do with the provision of potatoes, which are assuming a growing importance in the food of West Africa and elsewhere. Potatoes became an urgent problem in Russia when the food-growing areas were so severely cut down by the German invasion early in the war, and when transport was of overriding importance. This can be well illustrated in England, where yearly 100,000 tons of seed potatoes arrive from Scotland and Northern Ireland.

The transport problems were met by LYSENKO and POLUNIN, who cut out the reproducing portions of the potato and distributed these instead of the whole potato. The eyes of the potato clustering about its apex, or rose, are its reproductive elements, and at first "chats" of this region, about the size of marbles, were cut for distribution. Later, smaller portions of the skin about the rose, including the eyes, were substituted, and these "chips" have proved capable of producing a crop as assuredly as from normal seed. Thus 80 to 90 per cent. of the potato is saved where it grows, and the "chips," like the "chats," reproduce elsewhere, even on a small holding. Kew, adopting the Russian experiences, slices off "chips" with a sharp knife about the eyes of the rose-end of the potato, collects them, and seals up the scar. They are about a quarter of an inch wide at the widest. Collected on a bed of peat-moss, they remain for ten days, as they shrink. The shrunken "chips" are very light, twenty-four to the ounce, and as they retain their vital spark for one or two months, they can be flown to their approved destination in Malta, Cyprus, Palestine, or Kenya whenever air transport can be afforded.

The economic value which was sought of a vegetable of another kind was that of the common stinging-nettle. Its value as a companion to the potato on the dinner-plate was urged by the Kitchen Front without resounding success, but Kew found other employment for it. It was long known to yield a very strong bast fibre, once used in Great Britain for the manufacture of cloth, but discontinued because of other, cheaper, imported materials. But both in the last war and in this, Germany turned again to the nettle. In 1914-18 it yielded for them some 2000 tons of fibre for textiles, as well as 3000 tons of food and 3000 tons of by-products which went even into gas-mantles. It is, or was, in this war being collected in Hungary for use as raw material for textiles. Under the direction of Dr. R. C. METCALFE, experiments were made at the Royal Botanic Gardens and elsewhere on the value of the nettle for other purposes.

Tests then carried out confirmed the strength of the bast fibre, which consisted of a very pure form of cellulose. Other tests on fibre extracted at Kew were also made at the Imperial Institute and demonstrated that good-quality paper could be made from it. Larger quantities were prepared and submitted to paper-making firms in Scotland, and were pronounced so satisfactory that one firm purchased 1000 tons of nettles and another firm 200 tons for experiment. Several acres of nettles were cultivated in Scotland on land unsuitable for other crops. The upshot of these experiments on the bast fibre is that a fine paper, suitable for drawing or for water-painting on it, can be made from it. Not only that, but it will produce an artificial-silk fibre of the finest and softest quality.

There will, however, never be enough nettles available to satisfy more than a fraction of the paper requirements of Great Britain, so that attention may have to be turned from the bast fibre from the leaves to the wood fiber of the nettle-stem, which is reduced to pulp only with difficulty and expense. It is a bulky by-product for which other uses may be found. Before the war, dried stinging-nettles were imported from the Continent for the chlorophyll which can easily be extracted from them, and which is employed to impart a desirable shade of green to soap and other toilet preparations. It is also employed to a small extent in medicine . . . .

**Iowa Botanists in Mexico and Guatemala:** — Drs. I. E. MELHUS and G. J. GOODMAN of the Botany Department of Iowa State College returned in 1944 from a two months trip to Mexico and Guatemala. While there various economic plants were studied, especially corn. To study diversity and variability in this plant and to find new foundation stocks were among the objectives of the trip. Different types of corn were collected in the two countries and as a beginning of a long-time experiment various kinds of corn from the U. S., from Mexico, and from Guatemala were planted in each of these three countries. Locations were chosen for the plantings that would emphasize differences in latitude, elevation and other environmental factors. Ten different plantings averaging thirty-five varieties of corn in each planting were made in Guatemala alone. These plantings are at approximately the fifteenth parallel and ranging in elevation from about sea level to six thousand feet. The Mexican plantings range in elevation from a thousand feet to seven thousand feet. Experimental plantings of these seeds from the three countries were made in five places in the United States. The United States' plantings range in elevation from slightly above sea level to nearly seven thousand feet and from Brownsville, Texas, to as far north as the forty-second parallel. The expenses for the project were defrayed by the Botany Department (Iowa State College) May Gift Fund.

*Trinidad (British West Indies)*: **The Imperial College of Tropical Agriculture in War-Time:** — Once established, the continuity of British institutions tends to be maintained no matter what the impact of external circumstances may be. In the gloomiest periods of the years 1940-42 it was

a feature of life in Britain that bodies concerned with matters of cultural interest were not merely kept in being but in some instances even acquired a new vitality. The publication of the report of the Governing Body of the Imperial College of Tropical Agriculture, Trinidad, for the year 1943, serves to remind us of yet another instance of this continuity of the national effort in the arts of peace, this time in spheres remote from the European conflict—a continuity all the more remarkable in view of the difficulties that lie in the way.

Readers may perhaps recall that the Imperial College of Tropical Agriculture was founded to provide higher instruction in tropical agriculture and in the cultivation and preparation for market of tropical produce of every kind. Practically all members of the Colonial Agricultural Service pass through the College as a first stage, or otherwise have associations with it; thus the bonds that unite past students confer an almost unique unity and coherence to the collective personnel of this Service.

That an effort to maintain the College and its work should be made is not surprising. The developments and improvements that must be effected in agriculture in practically every corner of the Colonial Empire, both as immediate and long-range post-war aims, demand that preparations be put in hand now; and, as we have seen, the Imperial College of Tropical Agriculture is an integral part of the system.

What is remarkable is that it has been possible to keep the establishment actively in being, to continue the recruitment and training of students, to keep the long-term experimental programmes in operation, and to turn out a not inconsiderable body of research. This is a notable achievement; it is something in which we may take a legitimate pride. But it has not been without its rigours, both for staff and students. Most of the academic staff and their families, accustomed to home leave in a temperate climate every two years, have now been continuously in the tropics for six years. Even local travel, which helps to dispel the inescapable tropical *ennui*, has been seriously restricted. There have been periods of food restriction, and even scarcity, more rigorous than at home; and 'digging for victory' in the moist tropics—for that, too, has had to be done—is not quite the same pastime as in our own temperate clime.

Lack of transport provides the clue to the many difficulties. Thus Colonial Office scholars, going out to take the associateship course prior to being posted to different Colonies, have mostly arrived in small batches many months late. For example, the last of those due on October 1, 1942, arrived in the second week of April 1943! As in home universities, the defects of shortened courses have had to be borne. So, too, research work has been hampered by restrictions and delays in the arrival of apparatus and materials.

And so the tale of difficulties mounts up. The near view no doubt suggests a somewhat gloomy picture. But there is clearly another side to it. Agriculture is an art, and art is proverbially long. Nothing is more damaging to agricultural progress than restriction and discontinuity in the scientific research directed towards its improvement. In Trinidad, in spite of all set-backs (and they have been not a few), this essential continuity has been maintained. To those who have held the fort and advanced the tradition of science in its relation to agriculture, under the stress of war, a word of recognition is due. (C. W. Wardlaw *in* Nature).

# SERTA BIOGRAPHICA

VLADIMIR C. ASMOUS: **Dr. E. V. Wulff—A Victim of War:** — The tragic death of Dr. EVGENIĬ VLADIMIROVICH WULFF, one of the most outstanding and erudite botanists of the Soviet Union, killed by a bomb splinter on December 21, 1941, in Leningrad, is a great loss to botanical science and to all who knew this enthusiastic botanist and splendid man.

WULFF was born on May 25, 1885, at Simferopol in the heart of Crimea, the flora of which he loved so much and studied all his life. He was educated at Moscow University and obtained his Ph.D. degree from Vienna University in 1910. On his return to Russia he settled in Crimea and devoted himself to the study of its flora. In 1914 he became botanist of Nikita Botanical Garden (near Yalta) and was associated with this institution until 1926, holding for some time the position of director of that botanical garden. In 1922 he was appointed professor of botany at the University of Tauria (Crimea) and in 1926 removed to Leningrad, becoming first a specialist of the Institute of Plant Industry and eventually the curator of the Herbarium of Cultivated Plants in the Geographical Department of the same Institute, the position he held until his death. He obtained his degree of Master of Botany, in 1922 and was awarded Doctor of Biology *honoris causa* in 1936.

WULFF was a very versatile scientist, active in many fields of botanical science and author of more than 180 scientific works and articles. His chief interest was historical plant geography and his best and most widely known works belong to this class; they include: *Introduction to Historical Plant Geography* (in Russian, 1932, revis. ed. 1933) — a very valuable source of information on the history of development of vegetation in the whole world. It is the first part, covering general and theoretical problems, of a projected 3 volumes work, and it was translated into English (Chronica Botanica, "New Series of Plant Science Books," vol. x, 1943). The second part of this work under the title *History of the Floras of the World* was fortunately completed by WULFF before his death but it is not yet published. Another work of great value is *Historical Plant Geography* (in Russian, 1936) dealing with areas and the factors influencing their formation. Among other works we may mention: *Area and Age* (in Russian, 1927); *Versuch einer Einteilung der Vegetation der Erde in pflanzengeographische Gebiete auf Grund der Artenzahl* (in Russian, 1934 and in German, 1935) and *A. Humboldt. Plant Geography* (1936) — a translation into Russian of all articles by HUMBOLDT on plant geography with critical notes.

He was one of the best authorities on the flora of Crimea and the author of many important works and articles on that subject. The most important of them is *Flora taurica*, vol. i, fasc. 1-3 (1927-30) containing *Pteridophyta, Gymnospermae* and *Monocotyledoneae;* it is quite unfortunate that this so necessary and so well started work was never completed. The beginning of this flora was translated into German under the title *Flora der Krim, Conspectus florae tauricae* (1928). The results of his geobotanical investigations of various parts of Crimea are incorporated in many articles: *Die Vegetation der Jaila Gebirge der Krim* (Rus. and Germ. extract, 1925); *Kerch Peninsula and its Vegetation* (Rus., 1929) — two large and more important works, and *Demerdzhi and Karabi-Jaila in Crimea* (Rus., 1914); *Botanical Excursions to Jaila* (Rus., 1926), etc. The problem of the origin of the Crimean flora is discussed in three articles — *Origin of the Flora of Crimea* (Rus., 1926); *Entwicklungsgeschichte der Flora der Krim* (1926) and *Materials for the History of Flora of Crimea* (Rus., 1939) — and WULFF comes to the conclusion that the eastern Mediterranean element is predominant in the flora and vegetation of Crimea.

Besides this, he greatly contributed to the study of Crimea-Caucasian representatives of the families *Scrophulariaceae* (genera *Veronica, Verbascum, Celsia, Digitalis, Cymbaria,* etc.) and *Fagaceae.* We mention here as more important: *Crimea-Caucasian Species of Genus Veronica and their Importance for the History of Flora of Caucasus* (Rus., 1915) and *Die kaukasische Buche, ihre Verbreitung, systematische Stellung und Entwickelungsgeschichte* (Rus. and Germ., 1935).

Since his transfer to the Institute of Plant Industry he devoted a considerable part of his time to the study of economic and medicinal plants and published: *Essential Oil Plants* (Rus., 1930); *Essential Oil Plants, their Cultivation and Essential Oils,*

3 vols., with V. I. NILOV (Rus., 1933-37) and *The Most Important Cultivated Plants, their Description and Origin* (Rus., 1940). He was also co-editor with N. I. VAVILOV of the fundamental *Flora of Cultivated Plants of U.S.S.R.* (Rus., 1935- ), seven volumes of which are published up-to-date, and was a member of the editorial board of the *Bulletin of Applied Botany, of Genetics and Plant Breeding.*

WULFF always paid much attention to the history of botany and stated on many occasions that in order to know botany well it is necessary to learn its history. He made many contributions to that field of science. Perhaps most interesting of them are his works: *J. Koelreuter. On the History of the Problem of Sex in Plants* (Rus., 1934) and *J. Koelreuter, his Life and Works* (Rus., 1940). He published some valuable material on the history of Nikita Botanical Garden (1917-18, 1925) and on Simferopol Arboretum (1927) and on the life of a famous explorer of Crimea — CHRISTIAN STEVEN (1917). He also was the author of numerous biographical sketches of Russian (C. STEVEN, G. VORONOV, V. MONIUSHKO, etc.) and foreign botanists (W. GOETHE, A. HUMBOLDT, R. WETTSTEIN, A. ENGLER, H. HANDEL-MAZZETTI, etc.)

The untimely death of WULFF is not only a great loss to science but a severe shock to all his numerous friends. He was greatly respected and loved as a very kind-hearted, honest and modest man, always ready to help his colleagues and younger botanists with his vast knowledge and experience. He is survived by his wife and daughter; his only son is missing in action and probably killed.

A biographical sketch of WULFF with a good bibliography of his works is published by S. J. LIPSCHITZ in *Journal Botanique de l'U.R.S.S.* 28: 211-222, 1943*.

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F. W. WENT: **In Memoriam Anton Hendrik Blaauw:** — The death of A. H. BLAAUW, on November 11, 1942, in Holland, became only recently known in N. America. To the many admirers of his outstanding work and to those who knew this sensitive man more intimately, his passing will be received with sad resignation. For no one can doubt, that the premature end of this life of brilliant botanical achievements was hastened by the trials he had to share with his compatriots during recent years. His health always had been delicate, but in peace time his family and his assistants had learned to shield his high-strung nerves against the impact of the outer world, and thus his strength was preserved for creative research.

ANTON HENDRIK BLAAUW was born September 17, 1882, the son of a rural minister in one of the richest agricultural counties of the Netherlands: the Betuwe. His surroundings there not only awakened his deep love of nature and his interest in agricultural problems, but also gave him a strong religious and social feeling, which often showed itself in his later career.

After finishing his student years at the University of Utrecht in 1909, BLAAUW was forced to retire to the French Riviera to recuperate his health. In 1911 he had sufficiently recovered to make a study trip of half a year to the Dutch Indies, where in addition to research he devoted much time to photography, of which art he was a master. This is proven by his attractively written travelogue *de Tropische Natuur* (1913) which is illustrated with many black and white as well as colored photographs. For several years he was curator of Teyler's Society in Haarlem, a position which leaves the office-holder much time for research. During his vacations on the island of Voorne he gathered material for an extensive monograph of the history, biology and geology of the Lake of Rockanje.

When in 1918 the Agricultural School in Wageningen, Holland, was converted into an Agricultural College, BLAAUW was appointed the Professor of Plant Physiology, with the understanding that he would concentrate on the physiology of horticultural plants. In a splendidly equipped laboratory, built expressly for him, surrounded by a group of assistants and graduate research students who almost worshipped him, BLAAUW started research on the influence of accurately controlled external conditions on the development of bulbs, fruit trees and ornamental plants, especially those with pronounced periodic development. In the hands of BLAAUW and collaborators this work has yielded many important practical results, but its greatest value lies in the much deeper insight gained in the problem of periodic development of plants in general. Unfortunately the retiring character of BLAAUW was even expressed in his choice of journals in which the more than three-score articles describing this research were published: none of them (*Proceedings of the Netherlands Academy of Science, Mededeelingen Landbouwhoogeschool*) is generally distributed in botanical, agricultural and horticultural institutes, so that his research remained relatively unknown.

In these later years his health imposed ever-greater restrictions on outside activities. He never visited meetings or congresses, and even private discussions on scientific problems upset his nerves to such extent, that his associates only seldom admitted casual visitors to the professor's office. Thus only few botanists knew this quiet and always immaculately dressed man, his

* Just as this number of the Chronica is being printed off a copy arrived of Dr. WULFF's second volume of the "Historical Plant Geography," entitled "History of the Floras of the World," xix + 545 pp., 64 maps (Moscow and Leningrad). This volume contains a biographical sketch of WULFF by S. J. LIPSCHITZ and also a bibliography of the regretted author (pp. iii-xix). There are very extensive and valuable bibliographies at the end of each chapter. The book is entirely in Russian.

intellectual and kind face, his high straight forehead over large clear eyes, and his ascetic finely chiseled mouth.

BLAAUW's name will go down in the history of botany forever linked with two prominent achievements. In the first place he was the man who, through his investigations, liberated the field of plant tropisms from the strangling hold of the stimulus concept, and "BLAAUW's theory" became the battle-cry in one of the most vivid—and fruitful—controversies in botanical literature. In his thesis, published in 1909, he worked out the quantitative relation between light and phototropism, proving that the response to small quantities of light depends entirely on the *amount* of light energy falling on the plant. He showed that phototropism followed the laws of a photochemical process, and he became convinced that the elusive responses of plants to their surroundings could be explained on the basis of physicochemical laws.

The next, most important step in the explanation of phototropism was also taken by BLAAUW. In three papers (1914, 1915 and 1918), firmly based on an impressive array of factual material, he pronounced that phototropism is only a specialized case of the effect of light on growth in length. According to the "theory of BLAAUW" a phototropic curvature inevitably follows an exposure to light, whenever local differences in light intensity cause local differences in growth rate. He showed that in aphototropic organs light did not affect the growth rate, and that growth retardations following exposure to light were found in positively phototropic organs. This extremely simplified concept of phototropism unleashed a veritable storm of opposition, but after 20 years of controversy, BLAAUW's theory has become generally accepted as one of the two main mechanisms through which phototropism can arise.

The second field with which BLAAUW's name will forever remain prominently linked is the relation between temperature and development of plants. He started his series of investigations on this subject by analyzing the changes in the growing point in the course of normal development under the natural or usual horticultural conditions. Subsequent to this morphological work the physiological research was then aimed at identifying the optimal external conditions at which the various developmental stages were reached. Temperature was found to be by far the most important single factor influencing development. There were very marked differences between various species of bulbs with respect to the time of flower formation, as well as with respect to the optimal temperature and rapidity of this process. In tulips, daffodils and hyacinths complete data on the optimal temperature for each stage of development were obtained, which showed: (*1*) Each morphological stage has a different optimal temperature. Flower formation has a much higher optimum than vegetative growth and stem elongation. Root development has again a different optimal temperature. (*2*) For this reason an optimal temperature treatment of a whole plant is a compromise between the optimals for the different processes. Since some of these processes occur in succession, for a whole bulb a sliding optimum is found. (*3*) For growth in length a delayed optimum was found. At higher temperatures the actual elongation proceeds faster in the early stages of stem elongation, but is inhibited later, so that at some time after flower initiation the optimal temperature for growth as measured in final length is lower than for actual elongation at the time of exposure. Unfortunately no comprehensive review of this important work has as yet appeared in a generally distributed botanical journal, but a digest of some of BLAAUW's results was published by Miss PURVIS in volumes 5 and 6 of *Scientific Horticulture*.

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L. WINTER: **En Souvenir du Professeur Lucien Daniel:** — La France scientifique a perdu un de ses grands et dévoués serviteurs. Le professeur LUCIEN DANIEL est mort le 26 décembre 1940 à Rennes où ses obsèques eurent lieu le 30 décembre. Il repose aujourd'hui à Erquy (Côtes-du-Nord), où il a rejoint son épouse et son fils, celui-ci mort au Champ d'Honneur en Champagne, le 24 septembre 1915.

Toutes ses pensées, tous ses instants, toute son activité, le professeur DANIEL les consacra au service du pays. Il avait eu dans sa vie une grande espérance et une grande fierté: Il avait compté que son fils serait le continuateur de son œuvre. Déjà JEAN-LUCIEN DANIEL avait publié, de 1909 à 1914, de nombreux travaux, et en juillet 1914 il remettait avant son départ aux armées une thèse remarquable sur *l'Influence du mode de vie sur la structure des Dicotylédones.* Mais elle ne devait être publiée qu'à titre posthume en 1916. Dès lors, le professeur LUCIEN DANIEL n'eut plus qu'un but: poursuivre seul, avec acharnement et sans désemparer, la tâche qu'il s'était tracée et qu'il abandonna seulement huit jours avant sa mort.

Ses soixantes années de recherches, de travail patient et méthodique, peuvent servir d'exemple, autant que sa modestie, sa loyauté et sa franchise, parfois brutale. Doué d'un prodigieux sens d'observation et d'une capacité de travail peu commune, il devait être véritablement le "fils de ses œuvres."

D'origine paysanne, né à La Dorée (Mayenne), le 1 novembre 1856, il eut une vocation tardive. Abandonnant à 20 ans la ferme où il avait été élevé, il entre à l'Ecole Normale primaire de Laval où il en sort avec le no. 1 en 1879. Dès lors, il franchit rapidement les plus grands échelons. Après un court passage à l'Ecole primaire supérieure d'Ernée, puis au Lycée de Laval, comme répétiteur, il est nommé en 1881, professeur au Collège de Château-Gontier après avoir passé son baccalauréat. Puis le voici en 1887 et en 1890 respectivement licencié et docteur ès sciences. Sa thèse fut très remarquée dans le monde scientifique: *Recherches anatomiques et physiologiques sur les bractées de l'involucre des composées* (Ann. sc. nat. Bot., 1890).

C'est, pendant ces quatorze années passées à Château-Gontier, qu'il ouvrit une voie nouvelle à la Botanique et qu'il y prépara l'œuvre considérable publiée en 1902: *La Théorie des capacités fonctionnelles et ses conséquences en agriculture* (Bull. de la Soc. scient. et méd. de l'Ouest).

En 1895, sans qu'il l'eut demandé, il est nommé professeur de sciences naturelles au Lycée de Rennes; en 1901, il est autorisé à faire à la Faculté des Sciences un cours libre de Botanique appliquée à l'Horticulture. A la suite de ces cours qui firent sensation, une maitrise de conférences

de Botanique appliquée fut créée spécialement pour lui. Deux ans plus tard elle était transformée en chaire magistrale, chaire qu'il occupa jusqu'en 1927, date où lui fut conféré l'honorariat.

Bénéficiaire de nombreuses et hautes distinctions étrangères, surtout roumaines, hollandaises et anglaises, il fut fait officier de la Légion d'Honneur par le Gouvernement français en 1937.

Ses ouvrages* dépassent la centaine et certains d'entre eux furent honorés de souscriptions du Ministère de l'Instruction publique ou de récompenses appréciées: médaille d'or à l'effigie d'Olivier de Serres, de l'Académie d'Agriculture; diplômes d'honneur de la Société des Agriculteurs de France; médailles d'or de la Société d'Horticulture de France . . . .

L'Académie des Sciences lui attribua le prix de physiologie Phillipeaux, réservé jusqu'alors aux zoologistes et qui fut donné au botaniste rennais sur le rapport élogieux de l'éminent botaniste Guignard.

Vouloir retracer en quelques mots la carrière scientifique du Maître serait une gageure. Rappelons seulement ses travaux sur le greffage de la vigne et sa nomination comme rapporteur au congrés international de Lyon en 1901. Il mit en garde les viticulteurs contre l'abâtardissement de nos vieux cépages, la diminution de qualité de nos vins de grand crû et l'abondance causée par la reconstitution qui devait conduire à la mévente. Les événements lui ayant donné amplement raison, il fut chargé de mission par le Ministère de l'Agriculture, mission qu'il remplit consciencieusement, mettant le souci de la vérité scientifique au-dessus des intérêts particuliers. En 1914, il fut à nouveau chargé de mission par le Ministre de l'Agriculture et accrédité par le Ministre des Affaires étrangères près de ses agents étrangers. Après la guerre, il était à nouveau chargé de mission en Angleterre par l'Office National des Matières premières et rapporta de son voyage la vraie menthe de Mitcham qu'il propagea en France. Ce fut ensuite dans le Midi de la France qu'il fut chargé de mission concernant les plantes à parfum.

Une date dans sa vie fut celle de son jubilé scientifique, le 19 décembre 1936, qui fut célébré à Rennes lors de ses 80 ans. Un fort volume lui fut offert, édité spécialement, et réunissant des travaux originaux écrits par ses amis, ses admirateurs et ses anciens élèves.

La cérémonie était présidée par M. P.-A. Dangeard, membre de l'Institut, entouré de M. le Recteur d'Académie, du professeur Popesco, de Bucarest, de M. le Maire de Rennes et de plus de 70 collègues du professeur Daniel, venus de toute la France.

Il fut justement salué du titre de "*Fondateur de l'Horticulture scientifique*" et le monde horticole lui doit une vive reconnaissance.

En 1937, ses travaux, que nous avons eu l'honneur de présenter au Palais de la Découverte, lors de l'Exposition internationale, firent une grande impression. Cette exposition des travaux du professeur L. Daniel fut un résumé sommaire et une démonstration expérimentale synthétique de la *Théorie des Capacités fonctionnelles* et de ses applications dans le domaine des sciences biologiques. Elle comprenait deux parties:

(1) *Au Palais des recherches scientifiques*, une partie documentaire permettait de comprendre l'exposé de cette théorie, ses conséquences agricoles et horticoles, les résultats de la lutte pour la vie, l'hérédité des caractères acquis, l'obtention de nouveautés chez les végétaux autonomes ou greffés, le tout était appuyé par des aquarelles, dessins et photographies.

(2) Au *Jardin de la Biologie*, une seconde partie dans laquelle figuraient en nature des plantes vivantes et âgées, une manifestation unique dans les annales de l'Horticulture scientifique et pratique, par le nombre des bacs (152) et celui des pots en terre (21), dont le poids total était de 13.524 kilogrammes. Toutes ces plantes étaient nouvelles (symbiomorphoses et hybrides de greffe) et furent obtenues par le "*greffage créateur.*"

L'œuvre du professeur Lucien Daniel, comme on le voit, est considérable. Pendant plus d'un demi-siècle, il étudia l'arboriculture et le greffage en particulier. Dans cette branche, si longtemps restée empirique, il est devenu un maitre incontesté qui a mis de la clarté là où régnaient jusqu'alors la confusion et le désordre. L'originalité de ses méthodes, la hardiesse de ses vues et les résultats qu'il obtint lui valurent d'être très vivement combattu par les savants et les praticiens qui le considéraient comme un révolutionnaire.

Aujourd'hui, le temps a fait son œuvre; la majeure partie de ses idées a pénétré et triomphé dans tous les milieux, tant en France qu'à l'étranger. Ses méthodes ont fourni des résultats importants et se révèlent comme particulièrement fécondes. Il est à juste titre considéré comme un créateur de l'anatomie expérimentale.

On lui doit la connaissance de la structure du bourrelet d'union dans les greffes herbacées et ligneuses, ses conséquences fondamentales relatives au chimisme des associés à modes de développement différents. Les recherches se poursuivirent sur les variations qui en résultent pour la conservation de l'individu et de l'espèce aboutissant à la production de variétés nouvelles fournies directement par les symbiotes ou par leur descendance. Il obtint et ouvrit la voie à la production exceptionnelle de variétés nouvelles, de symbiomorphoses ou d' "hybrides de greffe", avec hérédité plus ou moins marquée, plus ou moins durable, suivant le cas, manifestant certains aspects de l' "hérédité des caractères acquis" soit par multiplication végétative, soit par reproduction sexuée.

De même, c'est à lui qu'est due la mise en valeur de la notion, si féconde et si largement utilisée aujourd'hui dans la pratique, du choix rationnel des sujets et des greffons dans la production et la défense des fruits de table et de pressoir. Il a, suivant le résultat utilitaire cherché, démontré qu'il existe des sujets *améliorants, détériorants* ou *neutres*. Il y a lieu de tenir le plus grand compte des adaptations réciproques qui s'exercent entre les milieux internes des associés qui dépendent à la fois de leurs propriétés ancestrales, du milieu extérieur et du mode de greffage utilisé.

En terminant, prenons à notre compte un fragment du discours prononcé par M. Galletier, alors Recteur de l'Académie de Rennes, lors des obsèques du Maître:

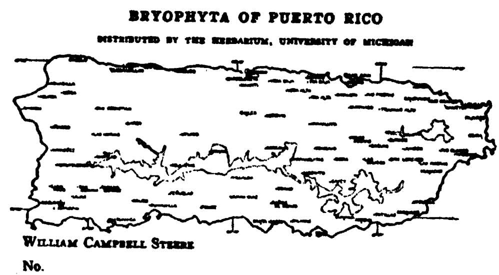
"Les honneurs et les distinctions, sur lesquels il a exigé que l'on fit silence, s'étaient, sans altérer sa simplicité, accumulés sur cet homme dont la renommée scientifique était plus qu'euro-

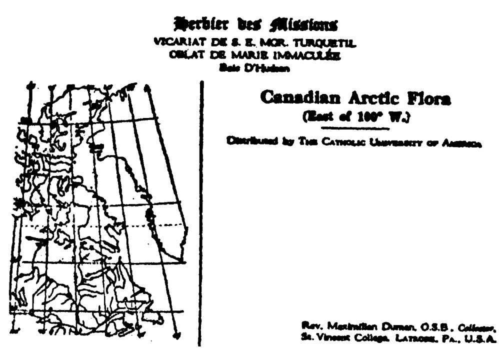
* Outre les ouvrages cités au long de cet article, signalons encore que le professeur Daniel fonda la *Revue Bretonne de Botanique* en 1906, et dont la publication se continua jusqu'en 1937. — D'autre part, il publia 4 volumes sur les *Etudes sur la greffe*, puis un autre sur *La question phylloxérique, Le greffage et la crise viticole*, et d'autres encore sur *L'hybridation*.

péenne, dont la réputation d'intégrité et de désintéressement était proverbiale, dont l'unique désir était de servir sa Bretagne et la France.

"C'est sous cet aspect qu'il revivra pour nous dans le dernier livre qu'il a publié: *Les mystères de l'hérédité symbiotique.* Dans ces 'ultimes pensées d'un vieux biologiste', dans ces 'pensées et critiques d'un vieil ignorant', nous aimerons à le retrouver avec sa science infinie, sa loyauté d'esprit, son humour, son ardeur combative, son sens aussi de l'incontrôlable et du mystère. Nul n'a su mieux que lui sentir les limites de la raison, pratiquer le doute et la modestie. A qui lui faisait un mérite de ses découvertes, il répondait volontiers que le temps est un précieux collaborateur pour quiconque expériment et que son grand mérite, à lui, était d'avoir atteint 80 ans!"

Directions des Jardins Publics,
Rennes, France.




C. B. Museum Schedologicum, 2-3 (*continued from* Chron. 4:453). — Samples of herbarium labels (greatly reduced) with maps in which the collecting locality may be marked with a cross. Of the above two labels the Steere label is in 2 colors, the map being red. The Duman label is entirely in black.

# BOOKS *and* PAMPHLETS

SALISBURY, E. J., 1942: **The Reproductive Capacity of Plants**, pp. 244 (London: Bell) 30*s.* — Under the above title E. J. SALISBURY, Quain Professor of Botany, University of London, has gathered together the results of observations over a fifteen-year period on the quantitative biology of seed production by British plants. Original data on the seed production of about 250 species — involving the examination of some hundreds of thousands of individuals and more than three-quarters of a million fruits, the counting of almost endless seeds and large numbers of germination tests — have been assembled by Professor SALISBURY in "an interlude of relative leisure at the outbreak of the present war," together with such fragmentary data of the sort that exist in a scattered and scanty literature. The author's approach to the problem of biological productivity is not that of an industrious dilettante who has carried home from field trips miscellaneous packets of fruits and seeds for spare-time analysis. His has been, on the contrary, a well-planned and thoroughly scientific campaign over the years to study in a comparative manner the reproductive capacity of selected species, proving at every step by statistical means the validity of observed differences and the significance of his subsequent conclusions.

*Average Seed Output* is defined as the mean of the average number of seeds per fruit times the average number of fruits per plant, plus or minus their probable errors. *Average Reproductive Capacity* is the preceding value multiplied by average percentage germination together with an estimate of the rate of vegetative multiplication. Professor SALISBURY's experience leads him to warn sharply against the employment of apparently average specimens as a short cut to the above terms. Although a number of individuals of a species may have a seed output that approximates a normal variation curve, populations may show variation curves that are highly askew so that *"average specimens"* are extremely misleading. This appears to be a fairly common occurrence in annuals and biennials, which may have a high proportion of small individuals.

What, we may ask, will that equally fictitious "average reader" of botanical books find among these tedious but impressive data? In the first place, I wish to say that he does not find the bane of serious ecologists, conclusions based on *a priori* reasoning, no matter how attractive and reasonable such conclusions may seem. For example, the orthodox principle, as stated by HERBERT SPENCER, that there is "a major adjustment of average multiplication to average mortality," is found to be quite contrary to fact. Professor SALISBURY says (p. 76), "Thus we are once more led to the conclusion that reproductive capacity is not merely a life insurance, a purely defensive measure, but a positive asset that surpasses the needs imposed by mortality and provides for the occupancy of fresh territory." A high reproductive rate, rather than being a mark of failure, is a criterion of success.

Throughout this series of studies a rational system of comparisons has been worked out that yields highly significant results for an understanding of many ecological and geographic problems. The author has studied seed size in relation to habitat, seed viability in relation to plant vigor, and seed output in relation to soil, climate, competition, life span, shading, site frequency, community type, and general conditions of colonization. Particularly striking are the data on congeners when the reproductive capacity of the species of *Scilla, Drosera, Papaver, Hypericum, Gentiana,* and *Linaria* is studied in relation to frequency, abundance, extent of area, and type of habitat occupied. From such data one finds clues to colonization, competition, succession, and other fundamental biological phenomena.

One wishes for space to set down a long list of Professor SALISBURY's discoveries, but this note can do little more than state that his discoveries are of lasting value. Students of community ecology everywhere now have before them the embarrassing evidence that they have neglected a fundamental characteristic of species which is of the greatest ecological importance; but they have also the advantage of clear statements of the problem, the need for its solution, and a sound methodology to follow. (S. A. CAIN, University of Tennessee).

STEVENS, NEIL E., 1944: **What it Takes to Teach the Plant Sciences** (Jour. Amer. Soc. Agron. 36:316-323). — Good teaching is a tradition of the botanical profession. This study of good teachers of the plant sciences is based on over 1,100 replies to a

questionnaire. The questionnaire used was the Purdue Rating Scale which was developed for the use of instructors who wish to secure the opinions of their own students. It gives opportunity to evaluate on a scale of one to 100 the following characteristics: Interest in subject, sympathetic attitude toward students, fairness in grading, liberal and progressive attitude, presentation of subject matter, sense of proportion and humor, self-reliance and confidence, personal peculiarities, personal appearance, stimulating intellectual curiosity. This scale was sent to 1,700 professional workers in the plant sciences, with the request that they rate as objectively as possible the teachers who had most influenced them or seemed the most influential in their undergraduate or graduate careers. The results published were quite incidental to the original purpose, which was to test the validity of the Purdue scale as a means of evaluating good teaching in this field.

The generous response — over 1,100 ratings from 1,700 letters sent — indicates a keen general interest in teaching and its problems. The wide distribution of the men scored seems significant. More than 400 individual teachers were rated. They represented three generations, widely scattered in the United States, with a sprinkling of Europeans. The highest number of returns for any one teacher was 22. Equally obvious was the wide divergence in the personalities of the teachers regarded as influential by their former students.

The averages of all the ratings classified on the basis of the present occupation of those who signed the questionnaire are given in tabular form. For the largest group, the named botanists, these are: interest in subject 90.3; stimulating intellectual curiosity 88.5; self-reliance and confidence 85.9; presentation of subject matter 83.4; sympathetic attitude toward students 83.3; fairness in grading 83.2; personal appearance 82.6; sense of proportion and humor 78.7; liberal and progressive attitude 78.5; personal peculiarities 78.4.

In addition, individual rating curves are given for the 17 teachers who received the largest number of scores in the various fields of plant science. All but one of these are anonymous, but they afford an interesting series of studies in divergent personalities.

One fact cannot escape the notice of the most casual reader: namely, that in whatever respect the individual teachers scored might differ, all graded high in two characteristics; interest in subject and ability to stimulate intellectual curiosity. Moreover, in all the groupings, agronomists or botanists, named or anonymous, these two characteristics received the highest average rating. This inevitably raises the question as to whether these two characteristics actually observed to be outstanding in over 400 widely separated successful teachers of the plant sciences may be the most important in teaching those sciences to the type of student reached by the questionnaire.

Whether this thesis is regarded as probable by readers will depend undoubtedly on their individual backgrounds. The study was not designed to throw light on this point. The results give no *direct* measure of the relative importance of these traits. Those who returned scores were not asked what characteristics they considered most important. Each characteristic was considered separately, without reference to the others. No objective criteria were set up. Each quality could be scored only against the scorer's individual ideal. Under such circumstances most professional educationists will reject the suggestion.[1] On the other hand botanists accustomed to dealing with living things, to making the best use of incomplete data and to finding interesting results quite unlooked for when a research was planned will be inclined to take these results rather seriously.

It is as if some horticulturist wished to get information on the old question of what makes a fruit variety successful. Specialists could readily prepare a rating sheet in the same manner as that in which the Purdue Scale was prepared, to include those qualities most frequently mentioned in published discussions of this subject.[2]

1. Potthoff, E. F., 1944: Comment on "What it Takes to Teach the Plant Sciences" (Jour. Amer. Soc. Agron. 36: 712-713).

2. See for example Tukey, H. B., 1931: The Trend in New Fruit Varieties (Proceed. Ohio State Hort. Soc. 112-124).

Such a scale would no doubt include such divergent characteristics as consistency of yield, earliness, drought resistance, cold resistance, insect resistance, disease resistance, color of fruit, flavor, freezing quality, shipping quality, etc. Some of these qualities are quite unrelated to one another, but all are of some importance. If it was desired to test the probable usefulness of the completed scale, it might, of course, be sent to another group of specialists for their opinion. Or another approach could be made: each correspondent could be asked to score the most successful fruit variety he had seen during some 7-year period of his life.

If the replies were so distributed that they covered three human generations and a wide variety of regions in the United States, as well as some in Europe, the investigator would be fortunate indeed. He would be doubly fortunate if the distribution was such that over 400 varieties of fruit were rated and if the rating sheets themselves clearly indicated that these individual varieties were widely divergent in many respects. If when the results were computed it appeared that these very divergent fruits judged by specialists to be successful were consistently scored high in some characteristics such as yield or shipping quality and on the average were scored much lower in others such as flavor, most students of crop plants would be tempted to suggest that the returns seem to indicate that a consistently high yield or shipping quality was more likely to determine the success of a variety than its flavor. One is almost tempted to start such a study.

Perhaps the best result of this paper and the work on which it is based, is the fact that the Division of Educational Reference of Purdue University is undertaking a similar study in other educational fields. (*Author's Abstract*)

**The "Proceedings of the Fourth Cotton Research Congress"**, held at Dallas, Texas, July 8-9, 1943, have been published in the form of an attractive 140-page booklet. The congress was organized by the "Statewide Cotton Committee of Texas" under the general chairmanship of BURRIS C. JACKSON. A. B. CONNER was chairman of the research committee and L. P. GABBARD of the editorial committee.

"Cotton Fights for Freedom" has been the theme of the Congress.

The booklet describes in details the Quartermaster Exhibit of War Cotton. The feature of this exhibit, arranged under the supervision of Mr. CHARLES K. EVERETT, was the dramatic display of cotton war uses which was designed and assembled by the Cotton-Textile Research Institute in behalf of the cotton textile industry at the invitation of the Quartermaster General of the United States Army.

A series of photographs of this unusual exhibit made up of seventeen correlated units demonstrates the utilization of scores of cotton items under actual combat conditions, such as cloth for the soldier's personal equipment, the fabric harness, webbing and parachute cords for the paratrooper, the canvas tarpaulins for jeeps and transport trucks, wind resistant and waterproof coated cotton fabric for protection against rain and cold, cotton to insure comfort, rest and protection in the tropics, cotton in arctic service, cotton for desert fighting.

Major BURRIS C. JACKSON, as Presiding Chairman of the Congress emphasizes the necessity for unity in the fight for removal of high tariff walls and other barriers, which impede and interfere with the "Freedom of Cotton" as a world commodity.

Mr. A. B. CONNER, Chairman of the Program Committee, stresses the point that if cotton is to serve in the fullest way in the future it must be supported by research in order to develop not only the production, but also the distribution and utilization of the products from cotton.

In the Introductory Remarks Mr. A. L. WARD, Educational Service, National Cottonseed Products Association, compares the fight our soldiers put up for Freedom and Peace with the fighting of cotton for freedom. The most important need in the American cotton world is for the development of hard, tough, aggressive, competent leaders, particularly leaders comparable to junior officers and non-commissioned officers in the Army.

The significance of cotton textiles to the armed forces was discussed by Mr. HUGH M. COMER, President, American Cotton Manufacturers Association, who stated that cotton has established itself in this war as second only to steel in importance to our armed forces. The fighting man "eats it, wears it and shoots it". Here is a testimonial

of a Southern contribution to the war, and it is a particular tribute to those men and women who carry on, from the planting to the finished products, in all its varieties, in the face of many wartime difficulties. Southerners — farmers and textile workers — have struck an all time mark in production, even though their numbers were at first reduced by other demands of the war. It is nothing short of a Southern triumph.

Mr. JOHN F. MOLONEY, Economist, National Cottonseed Products Association, points out that each of the cottonseed products is playing a significant part in the conduct of the war. They are serving on both the home front and the battle fronts. Cottonseed products are serving today in Tunisia, in the Aleutians, in the South Pacific, and wherever Americans are operating. The armed forces must have food, clothing, shelter, ammunition and the hundreds of other materials obtained from the cotton plant. In terms of such essentials, there are no by-products and main products. All are needed in the successful prosecution of total war. It is no exaggeration to state that no crop produced in America furnishes the volume and variety of essential war materials supplied by cotton.

Mr. CHARLES E. LUND, Chief, Fats and Oils Unit, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, discussing some of the broader phases of the place of cotton and cottonseed products in the Lend Lease program, draws the attention to the necessity of looking at the entire picture to see just what results the Lend Lease program and all the rest of the war program is having and will have in the future, on the whole domestic economy and on the international trade of the U.S.A. A basic international commodity agreement does not necessarily have to be restrictive. More emphasis should be given to the possibilities of increasing consumption and not all placed on restrictive possibilities.

Mr. J. B. HUTSON, President of the U. S. Commodity Credit Corporation, explains certain phases of the subsidies given to cotton and other farm products. He stresses the point that it is obviously less inflationary for the U. S. government to absorb a loss on the additional essential production rather than to move the prices of the entire production to higher levels. Limited and judicious use of subsidies will not cause inflation, it is the best method to increase the production of those commodities, which are badly needed at the present time. Mention should be made of the fact that cotton has been one of the least subsidized of industries.

Mr. FRANK A. BRIGGS, Editor, Farm and Ranch, especially recommends the use of good planting seed, the application of commercial fertilizers and asks for proper and intensive insect control.

Mr. A. B. COX, Director, Bureau of Business Research, University of Texas, in his lecture "Cotton, the Balance Wheel of our National Economy" states that the solution of the economic problems of the cotton growing and manufacturing region requires a constructive national policy toward cotton and cotton industries commensurate with their importance, but in addition to that the regions must be given relief from national legislation and regulation now handcuffing it in broadening its economy as a means of increasing and diversifying employment.

In "Cotton in the Agricultural Economy of Texas", discussed by various agricultural experts, recommendations are given to grow only those cotton varieties which spin and yield well, to take full advantage of all opportunities to grow cotton cheaply, to integrate the cotton enterprise with other farm enterprises, particularly livestock and finally to organize the farmer's market about the single variety gin community and sell cotton on the basis of its spinning performance.

"Cotton in Fashion" was an interesting subject discussed by L. GLADYS MCGILL, Professor, Home Economics Department, Texas State College for Women, and LUCILLE FINLEY, Research Assistant, Textile Engineering Department, Texas Technological College. The use of cotton as a fashion fabric has been stimulated in recent years by American designers and it has been found that cottons make possible not only atractive, but also adequate clothing for the woman of discriminating taste.

Mr. OSCAR JOHNSTON, the well known President of the National Cotton Council, emphasizes the importance of cotton as the one major item of export on which America has depended for the favorable balances which has made her great in international commerce. The following important statement was made by Mr. JOHNSTON:

"As the one agency serving all branches of the industry in all areas of the cotton belt, the National Cotton Council shall seek direct representation among the delegates who will sit at the peace table. It shall be prepared to utilize to the fullest its resources of manpower and of technical knowledge for the attainment of treaty provisions which are sound and workable, and which guarantee to American cotton a fair and just position in international trade. It pledges to you of this congress, and to the industry as a whole, its utmost efforts in the attainment of a fair and equitable share of world markets for the U. S. cotton industry and in the preservation of the principle of free and private enterprise in whatever system of world trade that may be established."

Mr. PETER MOLYNEAUX, Editor, Southwestern Banking and Industry, discussed in a more interesting manner the "Cotton Function in Postwar Planning". He draws special attention to the fact that it is characteristic of the economic theory that has ruled cotton policy in this country during the past ten years that emphasis has been placed on the control of production, with little or no attention to the stimulation and expansion of consumption. If the problem of a cotton surplus will be solved it will be done by measures to increase consumption, but not by measures to reduce and to limit production.

The last subject: Possibilities of Postwar Trade in Cotton, was assigned to Mr. LAMAR FLEMING, JR., President, Anderson-Clayton & Co., who treats the following overlapping stages in the return of international trade in cotton:

First, the now active textile countries, principally the U. S. and England, will furnish cotton goods to the war-torn countries as one by one, they become accessible again, and to the raw materials countries, principally in South America and Africa.

Second, the cotton-producing countries, principally the U. S., Brazil, India, and Egypt, will furnish raw cotton to the war-torn textile countries, as they reactivate their textile industries, mill by mill.

Third, Russia and China by degrees will rebuild their raw cotton production and become again largely independent of imported cotton.

Fourth, revival of European and Asiatic mill production in due course will make those countries independent of American cotton goods and probably will restore to them the role of furnishers of the textile imports of South America and Africa.

Fifth, if the world has a real will for peace, evolution will bring gradually greater world consumption than ever before and new production of goods and cotton in many lands.

In Mr. FLEMING's opinion the world will persevere in economic nationalism unless the United States abandons it and heartens other nations to do likewise; for, if the richest nation clings to this weapon, no lesser weapon can defend the other nations against it.

So the first and major decision will lie with the United States: Will she give up her high tariff policy? A second decision will lie with Great Britain: Will she relinquish her locks and keys to the vital gateways of navigation and recognize the rights of the rest of the world to equal use of the seas? A third decision will lie with all nations occupying or controlling undeveloped countries. Will they allow the more crowded peoples equal participation in developing and enjoying their natural resources? A fourth decision will lie with the U. S., England, and Russia, and our enemies: Will we all be tolerant of and not interfere with the political systems of other countries, except mutually to guarantee and exact a reasonable treatment of each other's citizens? (W. J. LUGARD, Board for the Netherland Indies, *New York City*).

WILSON, C. M., 1943: **Trees and Test Tubes, the Story of Rubber**, pp. 352 (New York: Holt) $3.50. — This book on a technical subject, the production and uses of rubber, is written by a professional writer and bears the earmarks both of the facility of writing that results from the author's profession, and the lack of insight of somebody not sufficiently acquainted with the rubber industry. The greater part of the book is well written and will be welcomed by persons who want to get a compilation of the newspaper reports and magazine stories concerning rubber. But no synthesis of views is attempted, and no reader will get a clearer understanding of the rubber problem as it stands today. The chapter on synthetic rubber, for instance, barely mentions the processes by which it is made; the title "Trees and Test Tubes" makes one expect to hear at least something about chemistry, but a succession of quotations and accusations does not even attempt to lift the smoke screen surrounding this subject. Perhaps this

is as well from the standpoint of military expediency, but it does not excuse the partiality with which practically every phase of FORD's grand failure of rubber plantations in the Amazon region is glorified, whereas the successful efforts of the British to grow rubber trees in Malaya are vilified. This is based mainly on pecuniary considerations. FORD never received a cent of profit from his venture, whereas the British (and Dutch and other Americans) made great profits from their rubber plantations in the Far East. Because there were profits, it follows inevitably (according to the author) that they were made by exploitation of the natives.

There is no doubt that the *Hevea* rubber industry is possible *only* in regions where abundant cheap labor is available. Doubling wages means a considerable increase in the actual cost of *Hevea* rubber, for about two-thirds of the cost of rubber production from *Hevea* is labor. But high prices will in normal times make it impossible for *Hevea* to compete with other rubber sources (such as synthetic and guayule). This would result in unemployment for those natives working in *Hevea* plantations; they would have to fall back on their own agriculture and maintain a much lower living standard. That this is true was experienced ten years ago, when rubber prices went far below production costs and many plantations had to suspend operations, so that the native labor had to look for other means of support. This problem has, of course, many other angles, each of which needs a special article for discussion; but the general fact serves to show that a blanket pay increase for all low-wage labor does not solve anything.

The author makes it appear as though the business sense of British and Dutch were mainly responsible for the rapid development of *Hevea* plantations in the Far East, implying that this was lacking in the American tropics. As a matter of fact, many experimental *Hevea* plantings were made all through Central and South America, but eventually most of them were abandoned because of (1) labor shortage and (2) the leaf disease. Neither of these problems has been solved as yet; consequently, a great South American *Hevea* rubber industry seems as uncertain now as it has been in the past.

The first chapters of this book deal with the history of rubber. One gives an extensive biography of CHARLES GOODYEAR, always in financial trouble, but with a sublime confidence in the future of rubber and his own inventions. Another, on the conditions and possibilities of collecting rubber from the wild *Hevea* trees, shows personal contact with the problem. In general, these first chapters are by far the best of the book, and are generally accurate, except for a few remarkable misstatements like "latex containing solids in the form of particles of rubber too small to be seen even in an ultramicroscope" or "most latex (in *Hevea*) is secreted from sacs," or describing guayule variously as an enormous family of bushes, a legume, or consisting of at least 800 different species.

The fifth chapter is the most objectionable of the book. In it the writer has made indiscriminate use of the threadbare clichés of the demagogue. The casual reader, already saturated with stories of labor exploitation in the Far East, probably will overlook the contradiction between the following statements, occurring in successive sentences: ". . . . American consumers . . . . had already *paid dearly in cash* to perpetuate the profits of the international rubber cartels . . . ." and "The United States public has *received wholly incommensurate benefits* from low prices of crude rubber. . . ." But it leaves a bad taste in the reader's mind. Only the critical reader asks, "What did the writer object to, the high cash payments for rubber, or the low price of rubber?"

Because of the flowery style, very wrong impressions are made, such as, "Indeed, Sumatrans were the very children of the dense tropical wilderness." This sentence suggests that the Sumatrans were living in a very primitive society. Nobody who has been in Sumatra, and knows something of the cultural accomplishments of the Minangkabau, Batak and other tribes will call them childern of the tropical wilderness, for they carved out of this wilderness a civilization of high aesthetic values. To call the Bataks "mountain nomads" is also utterly wrong, as any description of their picturesque villages will show.

The description of the development of Sumatra as a rubber-producing land of the first order is a curious mixture of thinly-veiled admiration for the accomplishments of the Dutch in terms of organization, labor laws, research and many other things, and serious accusations or insinuations against government policy (p. 96).

The author is extremely bitter against such trust agreements as the Stevenson

Act and the International Rubber Regulation Agreement of 1934. In his wrath he gravely misrepresents the facts. He claims, for example, that in 1940 this International Rubber Regulating Committee "was still permitting harvest and export of only about 53% of the rubber stands of Malaya and the Dutch East Indies." In reality the average index figure set in 1940 was 84%; it was increased to 100% during the first three quarters of 1941 and to 120% during the last quarter of 1941. He also claims that in 1934 world rubber prices were 13 cents per pound, increasing to 37 cents in 1937, and from 1938 on 20 cents and better. The officially published average figures for imports in the United States are: 9.8 cents in 1934, 18.5 cents in 1937, 14.1 and 16.0 cents in 1938 and 1939. Some of these prices still left a comfortable margin of profit, considering 10 cents "the legitimate production cost on reasonably well-managed farms or plantations," even after deducting transportation, insurance, and other trade costs. But this is a far cry from the profits the author claims, saying, "Once more the American public was the goat."

The chapter, "Henry Fordlandia," gives a rather piece-meal description of HENRY FORD's establishment in 1928 of rubber plantations in Amazonia. With utter disregard of previous experience in other rubber-growing countries, all bitter experiences of Far Eastern rubber planters — and even some extra ones — had to be lived through again, until the first rubber was harvested a couple of years ago. The book does not give any indication of how the labor problem is to be solved: for about one man is needed per 3-4 acres; 16,000 acres have been planted and FORD's plantation "has had considerable difficulty in holding its force of some 2500 workmen."

The following quotations characterize the final chapter, "Looking Forward." "After (a United Nations) victory is won at inevitably high costs in life, property and other resources, rubber production might *again be* the means of shaping the ruinous march of the retrogression of mankind, *once more might become* the effective tool of shrewd, selfish men, nations and political cliques who, in short-sighted greed, could wreck and nullify the forthcoming peace." "It is likely, indeed, that Japan may succeed in fleecing the rich East Indies more completely than Holland did." The latter remark refers to the profits, wages, etc., derived by the Dutch in 1940 from the Dutch East Indies. This was calculated to be slightly over 150 million dollars, which is considerably less than $700 per white inhabitant of the Indies. This figure should be compared with the $1000 income this year for every American. (F. W. WENT.)

**Pulle's Flora of Surinam:** — A report received via Sweden states that work on this publication is being continued regularly though this is of course difficult as the material of foreign herbaria is mostly not available. The following parts have been issued since the war began in September, 1939: —

Vol. II, Part 1 (publ. Nov. 1939): — *Polygalaceae* (A. J. P. OORT), p. 406-425, *Rosaceae* (A. KLEINHOONTE), p. 426-456. Additions and Corrections: *Euphorbiaceae* (J. LANJOUW), p. 457-470, *Monimiaceae* (J. LANJOUW), p. 471-472, *Myristicaceae* (S. J. VAN OOSTSTROOM), p. 473-475, *Menispermaceae* (F. P. JONKER), p. 476-477, *Malpighiaceae* (F. P. JONKER), p. 478-480, *Lauraceae* (A. J. G. H. KOSTERMANS), p. 481-487. Index to Vol. II, Part 1, p. 488-500.

Vol. II, Part 2 (publ. Dec. 1940): — *Mimosaceae* (A. KLEINHOONTE), p. 258-331, *Connaraceae* (J. LANJOUW), p. 332-340, *Annonaceae* (R. E. FRIES), p. 341-383.

Vol. III, Part 1 (publ. Jan. 1941): — *Turneraceae* (ELIZABETH BREMEKAMP), p. 342-354, *Quiinaceae* (J. LANJOUW & P. F. VAN HEERDT), p. 355-365, *Caryocaraceae* (J. LANJOUW & P. F. VAN HEERDT), p. 366-372, *Marcgraviaceae* (J. LANJOUW & P. F. VAN HEERDT), p. 373-385, *Dilleniaceae* (J. LANJOUW & P. F. VAN HEERDT), p. 386-408, *Linaceae* (R. C. BAKHUIZEN VAN DEN BRINK fil.), p. 409-411, *Humiriaceae* (R. C. BAKHUIZEN VAN DEN BRINK fil.), p. 412-421, *Lythraceae* (F. P. JONKER), p. 422-432. Additions and Corrections: *Malvaceae* (H. UITTIEN), p. 433-435, *Bombacaceae* (H. UITTIEN), p. 436, *Sterculiaceae* (H. UITTIEN), p. 437, *Tiliaceae* (H. UITTIEN), p. 438-441, *Melastomaceae* (J. LANJOUW), p. 442-443. Index to Vol. III, Part 1, p. 444-457.

Vol. III, Part 2 (publ. Jan. 1942): — *Erythroxylaceae* (V. WESTHOFF), p. 1-12, *Oenotheraceae* (F. P. JONKER), p. 13-34, *Rhizophoraceae* (F. P. JONKER), p. 35-43, *Oxalidaceae* (F. P. JONKER), p. 44-48 (p.p.).

Vol. IV, Part 2 (publ. July 1940): — *Verbenaceae* (H. N. MOLDENKE), p. 257-

321, *Avicenniaceae* (H. N. MOLDENKE), p. 322-325, *Asclepiadaceae* (F. P. JONKER), p. 326-352.

The following families are ready and will be published in the forthcoming months: —

Vol. I, Part 1: — *Gramineae* (G. J. H. AMSHOFF & J. TH. HENRARD), *Liliaceae* (M. BOTERENBROOD), *Amaryllidaceae* (M. BOTERENBROOD), *Iridaceae* (M. BOTERENBROOD), *Dioscoreaceae* (J. MELTZER).

Vol. III, Part 2: — *Theaceae* (P. F. VAN HEERDT), *Trigoniaceae* (G. DE MUNCK MORTIER).

K. S. HAO 1945: **The Genera of Chinese Woody Plants** (Chungking: Chun Hwa Book Co.) U. S. $12.00. — This book by the director of the Botanical Institute, National Academy of Peiping, has just been completed. It is one of the most extensive publications produced in China, during the war years and contains the names of Chinese woody plants, a key to families, a key to genera, sometimes also a key to species, and descriptions of families, genera and representative species. — The author (*cf.* CHRON. 4:529) asks us to state that his present address is: P. O. Box 66, *Peipei* near Chungking.

ERNST MAYR 1942: **Systematics and the Origin of Species from the Viewpoint of a Zoologist,** Pp. 334 (New York City, Columbia University Press) $4.00. — This book, written by a distinguished ornithologist, thoroughly and thoughtfully surveys the field of animal systematics. As its title suggests, the author has limited himself to this, his familiar ground, and has seemingly been at pains to avoid discussion of parallel and similar phenomena in the world of plants, a course doubtless initiated by the circumstances of the lectures which gave the book its form. Nevertheless, despite this fact, it stands as a competent and authoritative guide to systematic practice in general and will be studied profitably not only by the plant systematists but also by other botanists who would learn the objectives and points of view of taxonomy. This is its immediate and utilitarian value; but the book goes far beyond in what might be termed its theoretical content. In this it achieves three main objectives. It demonstrates the value of the concept of the polytypic species. It presents a sober and cogent argument for the dynamic interpretation of species by a systematist of wide practical experience. It marshals the evidence from zoology for species formation as a concomitant of geographic differentiation. Its arguments cannot be ignored by students of evolution. They are provocative and stimulating.

The systematist is and has been primarily a student of natural variation. But he has been limited in his analysis of it by the meager samples with which he has had perforce to deal. Furthermore, recognizing that it is his first task to create an orderly catalog comprehensible to other workers, the systematist has concentrated his attention upon the detection of natural entities, and in describing them, has described them chiefly from the standpoint of their differentiation and recognition. His "descriptions" have been meant to be diagnostic of the entities he has perceived rather than descriptive of their variability. Content with the methods which would serve this limited purpose he has for the most part failed to adopt or to develop methods which would reveal and make explicit the nature and degree of this variability. Hence systematic works give the impression that species are relatively uniform. Dr. MAYR has reviewed the evidence of intraspecific variation from systematic zoology, in some fields of which biometric methods are more commonly employed than in systematic botany. He demonstrates that, by the analysis of variation as it is geographically expressed, the systematist can argue back from the accomplished facts of evolution and infer the processes which have produced them. Because of sexual differentiation and more complex life histories than is the habit of most plant groups, most animal groups are more complex in their pattern of variation, particularly in the realm of discontinuous variation. Nevertheless, a careful study of the examples which are discussed by MAYR will reward the plant systematist by giving him a base of comparison from which to analyze the geographic structure of his own groups and in this way may enable him to devise new methods both for the analysis of variation and for its presentation.

The systematist has long recognized the fact that discrete entities do exist in nature even though his methods of description have raised doubts in the minds of other workers. He has long recognized the fact that, if morphologically "distinct" to a certain degree, these entities are separated by a physiological barrier of some kind. A number of familiar examples continually remind him of this fact. But in most groups of plants and animals, experiments to determine the existence of these barriers and their nature have been, if not impossible because of the nature of the organisms concerned, at least not applicable on a wide scale. Hence, the systematist has relied almost wholly upon the degree of morphological difference as the criterion for specific segregation. He has unnecessarily and unwisely come to regard this criterion as largely sufficient in itself. Yet reference to any comprehensive taxonomic monograph reveals at once a not inconsiderable divergence of opinion on the part of equally competent botanists as to the degree of morphological difference required in this instance or that. Relying solely upon this criterion, some systematists have been prone to describe as specific any striking variant, without reference to the variation pattern of the group as a whole; others have sought to reduce the concept of the species to the least common denominator, recognizing as species any well defined population. In the case of those species with continuous geographic distribution which present a gradient between two or more morphologically different components, such components have been considered both as specific and as subspecific, depending upon the judgment and "taste" of the worker concerned. In the case of entities which are similar in many respects but dissimilar in

others and which are geographically separated beyond the range of interbreeding, it has been and is still the practice to recognize them as species. In other words spatial isolation of populations has been thereby added as a criterion ancillary to morphological difference.

MAYR shows by his discussion of geographic variation and the evidence for the polytypic species that neither of these criteria, alone or taken together, are sufficient for more than the purposes of pragmatic cataloging, and that they do not portray the pattern of variation as it exists in nature. As a working systematist he is convinced that the concept of the polytypic species is of immediate practical value in systematics, by reason of the simplification which it entails. By this concept, which is essentially the same as those of KLEINSCHMIDT, RENSCH, TURESSON, and CLAUSEN, KECK and HIESEY, he means to imply that in a group of morphologically similar organisms, entities which replace each other geographically, whether spatially isolated or not, are more likely to be subspecific rather than specific. In other words, the spatial fragmentation of a population may have induced morphological differentiation of varying degrees, but need not have produced specific segregation. The evidence which he and others have adduced, particularly from zoology, is convincing, but whether this concept can be applied as sweepingly in plant systematics as MAYR suggests for animals, remains to be explored. Differences in evolutionary processes and in breeding structure, as well as differences in mobility and possibly in adaptive potentials, indicate that it cannot. Nevertheless, at the very least, the concept and the evidence which supports it does require the systematist to analyze the variation pattern of the whole of any group and its possible causes before he makes any decisions as to specific segregation.

If neither the degree of morphological difference nor spatial isolation can be safely employed for the determination of biological specific limits, what then remains to the systematist if he aspires to do more than catalog discontinuities? He can no longer rely upon his established criteria and new ones are as yet scarcely available, for the agents which induce specific segregation are unapproachable by the methods with which he is familiar. What course, then, is open to the systematist, who, after all, must make a decision in the particular cases before him? MAYR suggests that the answer lies in the dynamic concept of the species which he has adopted, supplementing DOBZHANSKY's viewpoint with his own. This concept simply implies that we interpret species as the changing multiform entities which they are, caught by our senses and thus rendered static at this moment of time like the image on a celluloid film. Although we may be ignorant of the agents which induce species formation we can still infer their effects and the results of their actions on living populations. MAYR therefore urges (as has the writer) that the pattern of morphological variation which is geographically expressed be employed as a clue to biological isolation. This course is admittedly an expedient, and the inquiring systematist will remain unsatisfied until he possesses full and exact knowledge of the isolating mechanisms and their functions. Until that time comes, adoption of this course will not only serve to place the practice of systematics upon a more objective basis, but will itself contribute to a study of the isolating factors. Its adoption will require more critical studies of variation and the development of new methods, both for analysis and presentation. It will require the systematic study of the distribution of variants with reference to their breeding structure, and, as MAYR points out in his chapter on the Biology of Speciation, the investigation of the breeding structures themselves. Such investigations obviously cannot be made in the herbarium or the museum alone, for both are enclosed by a mirror which, although it reflects faithfully what is within, obscures the vision of the living world without. When, like Alice, the systematist steps through this mirror, he will enter a new world but it will be a world of reality and not a shadow. (CARL EPLING, Univ. of California.)

ALEXANDRE GUILLIERMOND 1941: **The Cytoplasm of the Plant Cell**, tradução de Dr. L. R. ATKINSON, pp. 247 (Waltham, Mass., the Chronica Botanica Co.; Rio de Janeiro e São Paulo, Livraria Kosmos) $4.75. — Não deve existir botânico algum no mundo, e muito menos nenhum citologista, que não conheça o nome do Prof. GUILLIERMOND. Professor de Botânica na Sorbonne desde 1935, a sua elevação à cátedra da célebra Escola Superior de Paris não foi o início de uma carreira de relêvo, antes a consagração de uma vida activa de trabalho profícuo, de uma obra notável de cientista e de professor.

Para aqueles que tralbalham em laboratórios de Citologia, GUILLIERMOND é o grande mestre que se impõe pelos seus métodos de trabalho, pela seriedade da sua obra, pela fecundidade do seu labor. A obra que tem realizado é vastíssima, abrangendo os grupos mais diversos do Reino Vegetal, desde as Bactèrias, Cianoficeas, Algas e Ascomicetos, até as plantas superiores. Mas foi sobretudo nos estudos sôbre o vacuoma e sôbre o condrioma e o plastidoma, que o nome de GUILLIERMOND adquiriu o renome internacional de que hoje gosa.

Estas simples palavras, que são preito de homenagem de um citologista modesto que se curva perante o mestre, bastam para, apresentando o autor, dar idea do quilate da obra. *The cytoplasm of the plant cell*, sem ser o livro esgotante que é o seu *Traité de Cytologie*, é o livro moderno, a um tempo expositivo e critico, onde os trabalhos dos mais variados investigadores são citados e discutidos, onde as mais diversas hipóteses encontram o seu lugar próprio, onde todos os assuntos do citoplasma têm o seu desenvolvimento adequado.

Começa o livro de GUILLIERMOND por uma introdução onde se citam as primeiras investigações sôbre a célula e onde se fala dos métodos de investigação citológica. Seguem-se depois quatro capítulos onde se trata da estrutura da célula e constituintes citoplásmicos, das propriedades fisicas do citoplasma, da sua constituição química e da sua constituição físico-química. Os capitulos 6 a 11 são dedicados ao plastidoma e ao condrioma e às relações entre estes dois tipos de organitos. O estudo dos vacúolos e das formações de Golgi e de Holmgren ocupam os capítulos 12 a 17. No capítulo 18 trata-se de lipidos e outros produtos metabólicos e no capitulo 19 das alterações citoplásmicas devidas à morte do citoplasma,à acção de agentes físicos e ao parasítismo. O capítulo 20 constitute um resumo dos trabalhos e conclusões sôbre o condrioma, o plastidoma e o yacuoma. Termina o volume por uma extensa lista bibliográfica e pelos indices.

Grande parte dos capítulos reservados ao estudo do condrioma é dedicada às hipóteses que

têm sido apresentadas sôbre as relações entre o condrioma e o plastidoma. Aí, GUILLIERMOND, amplia a sua hipótese da dualidade do condrioma, trazendo larga soma de argumentos e discutindo trabalhos de numerosos investigadores. Prestando homenagem ao trabalho de GUILLIERMOND, não podemos no emtanto deixar de fazer aqui um reparo.

A-pesar-dos argumentos apresentados, não encontrámos ainda razões suficientes para distinguir, por exemplo, em células meristemáticas do vértice vegetativo de *Elodea canadensis*, material que nós também estudámos, cloroplastos (ou condriocontos plastogénicos?) e condrioma *inactivo*. São as mesmas as reacções microquímicas. Porque dizer que os elementos da última categoria mantêm a sua forma e as suas dimensões? Tendo reconhecido, como GUILLIERMOND também reconheceu, que, nas células diferenciadas, aparece maior número de condriocontos, porque não admitir o alongamento das mitocôndrias granulosas? Seríamos assim levados, a atendermos ainda à *actividade do condriomi inactivo*, nos fenómenos de secreção, por exemplo, ao estabelecimento da *teoria da evolução do condrioma*, que noutro lugar apresentamos.

O estudo do vacuoma é também um estudo demorado. Depois de passar em revista os clássicos trabalhos de DE VRIES e VAN TIEGHEM, faz a história das investigações que se seguiram, no que diz respeito ao método de coloração vital, à constituição do suco vacuolar, à determinação do suco vacuolar, à determinação do $pH$ e do $rH$, à origem dos vacúolos, à natureza dos grãos de aleuroma, do aparelho de Golgi e dos canalículos de Holmgren, e por fim ao papel do vacuoma na vida da célula.

Desta exposição se pode ter uma idea, ainda que pálida, do valor desta nova obra que GUILLIERMOND junta à sua vastíssima e notabilíssima bibliografia. Representa um magnífico tratado ao dispor do público de lingua inglesa, que fica a dever à "Chronica Botanica" o inestimável serviço de tornar conhecida, em conjunto, a obra de tam grande citologista.

Acresce a tudo isto que a impressão se faz num tipo não fatiga o leitor e que todos os assuntos estão profusamente documentados por admiráveis gravuras. (A. GONÇALVES DA CUNHA).

# NOTICES *and* QUERIES

► **A Dictionary of Popular Plant Names:** — Announcement is hereby made of an index to the common and vernacular plant names of the world now in preparation by E. C. WILLIAMS of the Los Angeles County Museum and H. N. MOLDENKE, Associate Curator of the New York Botanical Garden.

The compilers have been working on this project already for quite a number of years and have assembled half a million or more names. The work is now being pressed even more intensively and it is hoped that the Dictionary may be ready for publication soon after the conclusion of the war. The work is planned as a supplement to VAN WIJK's classic volumes, not repeating material in these volumes, but bringing them up to date and including names in the many other languages not treated by VAN WIJK, including native names from all over the world. After the publication of the Dictionary the compilers plan to continue the project by means of supplements issued every few years in the manner of the *Index Kewensis*.

The compilers request readers of this announcement to please bear the project in mind and to send them lists of common and vernacular names (with the scientific names of the plants to which each applies) which they might otherwise overlook and to send them references to any published works wherein such names are listed or incidentally mentioned and which might otherwise be overlooked. To make this Dictionary as complete and accurate as possible is to the advantage and benefit of all botanical workers everywhere. Librarians, botanical students, teachers, museum and herbarium workers, geographers, economic botanists, foresters, pharmacists, anthropologists, and laymen reading accounts of travel in foreign lands, have long felt the urgent need of one volume or series of volumes in which they could find the scientific identifications of the many common, popular, and vernacular plant names met with in past and current literature, in the press, and in the horticultural and pharmaceutical trades. The Dictionary by WILLIAMS and MOLDENKE is being planned to fill this need.

Please send names and references to:—

E. C. WILLIAMS,
Los Angeles County Museum,
Exposition Park,
*Los Angeles 7, California,*
U. S. A.

*or*

HAROLD N. MOLDENKE, Ph.D.,
New York Botanical Garden,
Bronx Park,
*New York 58, New York,*
U. S. A.

► **'Who's Who in the Western Hemisphere':** — A large number of botanists and agronomists in North, Central and South America received a questionnaire, some time ago, from the Editors of "Who is Who in the Western Hemisphere." This publication did not materialize. If we have been well informed the "firm" who planned this publication has disappeared. A complaint has been filed against the firm by the Federal Trade Commission (*cf.* Congressional Record, 78th Congress, 2nd session, Wednesday, Jan. 12, 1944) and the Post Office Department has entered a fraud order against them, we believe. We mention these facts in detail as the irresponsible editors of the publication referred to above, have used our "List of Plant Scientists in Central and South America" (1942) as a mailing list, in some cases giving the impression that their publication was related in some way with the CHRONICA, in other cases prominent U. S. botanists were listed as sponsors or collaborators. — Any colleagues in Latin America who filled out a form for "Who is Who in the Western Hemisphere" should send a copy to Mr. WHEELER SAMMONS, A. N. Marquis Co. (since 1899 publishers of the authoritative bi-annual Who's Who in America), who is preparing a "Who's Who in Latin America" (ed. 3) in coöperation with Stanford University, California.

► **Cuatrecasas' Notas a la Flora de Colombia:** — Some sets of reprints of CUATRECASAS' Notas a la Flora de Colombia I-V, 1939/42, have been deposited with Messrs. G. E. Stechert, 31 East 10th Street, *New York City,* and may be obtained from them at $100.00. These rare reprints from the *Revista Colombiana de Ciencias Exactas, Físicas y Naturales* contain descriptions of numerous new species and many illustrations.

► **Saccharum spontaneum from Anatolia:** — The area of distribution of *S. spontaneum* is very extensive, including, among other countries, Formosa, southern China, India and Egypt. During a stay in Minor Asia in October 1939, I found vast fields of

*S. spontaneum* in the plain of Adana, on the southern coast of Anatolia. The occurrence of *S. spontaneum* in this district has not hitherto been known, although it was to be expected because of its extensive area of distribution. It is remarkable that *S. spontaneum* winters here in a climate in which the January temperature may fall below -6°C. Similarly, in the plain of Ceyhan, north of Adana, where the temperature may fall below -10°C, I found *S. spontaneum,* although in smaller quantity. In subtropical cane districts, such as Louisiana, North British India, New South Wales, Argentina, etc. frost-resistance is an important factor in cane growing. There is the possibility that this form of *S. spontaneum* will be of some value in cane breeding. The writer will be very happy to offer his services in sending seed and fuzz of *S. spontaneum* to anyone interested in such breeding. (Dr. C. VAN DILLEWIJN, Agricultural College, *Wageningen*).

► **Gray Herbarium Card Index:** — Beginning with the July issue, the subspecies, varieties and forms of flowering-plants and ferns published between 1753 and 1886 will be included in the Gray Herbarium Card Index. Those published since 1886 are already included. Any institution considering the purchase of the current issues should send their order to the Bibliographer, Gray Herbarium, 79 Garden St., *Cambridge, Mass., U. S. A.*, as soon as possible in order to have a complete series. A subscription can begin at any time, but this is an especially advantageous moment.

► **Saccardo's Sylloge Fungorum:** — Dr. JOHN A. STEVENSON, Senior Mycologist, Bureau of Plant Industry, Beltsville, Maryland, realizing the necessity of a reprint of the above work, and the librarian of the U. S. Dept. of Agriculture, Mr. RALPH R. SHAW, approached Messrs. Edwards regarding the possibility of reprinting this set, and advised prospective buyers of the fact that a reprint was under consideration. — On the basis of advance subscriptions or indicated interest, the sales price was set at $200.00 for the set and $10.00 per volume as bound (like the original, volumes 22 and 24 are bound in two volumes each). — In view of the fact that original copies within the past ten to fifteen years have fetched $2,000.00 and more in spite of the fact that they were not always completely made up of original publications (the first ten volumes were reprinted at least twice), this is an opportunity that no mycologist can afford to miss. — For the sake of economy, both from the standpoint of paper and printing cost, Messrs. Edwards have reduced the printing surface of the volumes seven per cent. This does not affect the readability to any appreciable degree. The paper used in the reproduction was tested by the U. S. Nat. Bureau of Standards; the volumes are solidly and attractively bound in library buckram. — Orders may be sent to the Book Dept., the Chronica Botanica Co., *Waltham, Mass., U. S. A.*

► **British Publications on Mycology and Plant Diseases:** — The British Mycological Society is making a collection of surplus reprints and pamphlets on mycology and plant diseases for distribution after the War to libraries and centres of research at home and abroad which have suffered loss or damage. Authors are invited to send reprints of their own published work and any other reprints or pamphlets which they can spare to Mr. G. C. AINSWORTH, secretary of the British Mycological Society, Imperial Mycological Institute, Ferry Lane, *Kew, Surrey, England.*

► **Alpine Plants:** — Mr. W. E. TH. INGWERSEN has continued his list and descriptions of Alpine Plants by the issue of No. 7, which commences with *Abronia* and concludes with *Adenophora.* The separate parts are of handy size, and 6*d.* each from the author at *Gravetye, East Grinstead, Sussex, England.*

► **New Edition of the Bergey Manual of Determinative Bacteriology in Preparation:** — Recently a former president of the *Society of American Bacteriologists,* and a man intimately in touch with current bacteriological research made the remark that he felt that the coöperative research that has been under way since 1939 by a group of from 40 to 50 specialists that have been working toward the publication of a new edition of the *Bergey Manual,* represented the most important piece of coöperative bacteriological research that is in progress in America at the present time. Probably many readers will feel this an over-statement of the case. But the mere fact that the statement was made in all seriousness by a competent observer is stimulative and provocative of thought. — Before Dr. BERGEY died, he had, under the auspices of the Society of American Bacteriologists, utilized certain of the royalty funds received from the sale of this volume for the development of bibliographical references in the Manual. The results of this investment became evident in the fourth edition of the volume. Later when the Society turned all of its rights to royalties back to Dr. BERGEY, he established (Jan. 2, 1936) the *Bergey Manual Trust* with the

royalty fund, to care for the continuation of the work that he had started with the aid of a committee from the *Society of American Bacteriologists* in 1923. The *Bergey Manual Trust* is managed by a Board of three Editor-Trustees,—Prof. E. G. D. MURRAY, McGill University, *Montreal, Canada;* Prof. A. PARKER HITCHENS, now in charge of the work developed by Dr. BERGEY for so many years at the University of Pennsylvania, *Philadelphia, Pennsylvania*; and Prof. ROBERT S. BREED of the New York State Experiment Station, *Geneva, New York,* Chairman. — The Editor-Trustees sought and secured the coöperation of additional bacteriologists interested in developing the systematic relationships of various groups of bacteria. The value of this coöperative work became evident with the publication of the fifth edition of the Manual in 1939. Since 1939 this group of individuals has continued its work though the number of participants has been decreased by the death of Dr. D. H. BERGEY (Sept. 5, 1937), Dr. GLEN P. VAN ESELTINE (Nov. 15, 1938), Dr. F. D. CHESTER (Jan. 1, 1943), and Dr. A. T. HENRICI (April 23, 1943). New workers have taken their places and others have joined in the work so that the new edition when it appears will mark another step forward in developing order out of the confusion that has reigned in the field of bacteriological taxonomy. Further notice with announcement of the definite date of publication will be given when this becomes possible. — From the beginning the undertaking has had the support of Canadian as well as U. S. A. bacteriologists. It is to be regretted that international conditions have prevented the development of a larger international participation in the work. It is hoped that such coöperation can be developed in the future so that the book may become truly representative of the best thought of bacteriologists throughout the world. — Suggestions for the improvement of the Manual are always appreciated by the Board of Editor-Trustees.

► **Tree Measurements:** — Timber measurers, in the ordinary course of their work, accumulate a vast body of data. By summarizing, a certain amount of useful local information is obtained. But its full value can be realized only by pooling the local data, and making it available, both in summary form and as tables of general application. — The *Scheme for Pooling Tree Measurements,* taking advantage of the present heavy rate of felling, makes provision for collecting data upon a mutual basis. Details may be obtained from Mr. REGINALD DAVEY, M.Sc., *Sandymount, Nutley, Sussex, England.*

► **Kodachrome Slides showing Nutrient Deficiency Symptoms:** — The National Fertilizer Association has issued a catalog of kodachrome slides showing nutrient deficiency symptoms in a wide variety of plants. The collection has been made in cooperation with agronomists, horticulturists, and plant physiologists. Duplicates of the original slides may be ordered by any agricultural worker or teacher or any other interested person. A copy of the catalog may be obtained upon request to the Association, 616 Investment Building, *Washington 5, D. C., U. S. A.*

► **U. S. Fungus Disease Registry:** — Dr. ROGER DENIO BAKER, associate professor of pathology in charge of surgical pathology, at Duke University School of Medicine has been appointed professor and chairman of the department of pathology in the Medical College of Alabama at Birmingham, a division of the University of Alabama. He moved to Birmingham on Dec. 1, 1944. Dr. BAKER requests that autopsy and surgical materials for the Fungus Disease Registry be sent to him in the future at *Birmingham 5, Alabama, U. S. A.* The mycologic and serological materials of this Registry should continue to be sent to the office of Dr. DAVID T. SMITH, Duke Hospital, *Durham, North Carolina, U. S. A.*

► **Fedele's Monografia del Pioppo:** — Certain bibliographies list the following title 'V. FEDELE 1907, Monografia del Pioppo, 12°, pp. xv + 220, Casale Monferrato'. There is no copy of this in the library of the U. S. Dept. of Agriculture or of the Arnold Arboretum. Anyone who can give some information about this is kindly asked to communicate with the Library of the Arnold Arboretum, *Jamaica Plain, Mass., U. S. A.*, and with Dr. ERNEST ROULEAU, Herbier de l'Université de Montréal, 4101 est, rue Sherbrooke, *Montréal, Canada.*

► **Russian Papers on Cereal Rusts:** — Dr. K. STARR CHESTER, Dept. of Botany and Plant Pathology, Oklahoma Agricultural and Mechanical College, *Stillwater, Oklahoma, U. S. A.*, has prepared translations of a number of Russian papers on cereal rusts. These translations have been deposited with Dr. STAKMAN at St. Paul, Minn., with Dr. CRAIGIE, Winnipeg, Manitoba and at Dr. CHESTER's office, where they are available for loan or film copying. A list of these papers may be obtained directly from Dr. CHESTER.

► **Biological Abstracts—Clipping and Pasting:** —Individual subscribers to sections of Biological Abstracts (Univ. of Pennsylvania, Philadelphia, Pa.) may obtain second

copies of the sections in which they are interested at reduced prices ($2.00 for most sections, except sections B, F, and G, which cost $2.50) for clipping and pasting purposes.

► **Republication of Old Scientific Works:** — Some time before the Second World War a committee of the Int. Organization for Intellectual Coöperation, convened by the late Dr. B. NEMEČ of Prague (*cf.* Nature 141:194, 1938, etc.), suggested the republication of a number of biological classics, including:

(1) "De proprietatibus rerum", by BARTHOLOMEUS ANGLICUS (facsimile reproduction of the illustrations which appeared in all the editions, summary of each chapter of the original work, and a biography of the author).
(2) "Micrographia", by ROBERT HOOKE.
(3) "Opuscula Botanitii argumenti", by RUDOLPH CAMERARIUS.
(4) "Origin of Species", by DARWIN (a reprint of the first edition, 1859).
(5) "Expériences pour servir à l'histoire de la génération des animaux et des plantes", by LAZARO SPALLANZANI.
(6) "Disquititio de sexu plantarum", by LINNAEUS.

The editors of CHRONICA BOTANICA would like to have comments of historically minded colleagues about the need and usefulness of republishing the material referred to above. Suggestions about other desirable reprints have reached us lately repeatedly. Such suggestions are very welcome. We plan to devote one number of several forthcoming volumes of the Chronica to a reprint edition of interest. This series was started with RAFINESQUE'S *Life of Travels* (CHRON. 8, 2, 1944).

► **Books owned by Thomas Jefferson:** — Dr. RANDOLPH G. ADAMS, director of the William L. Clements Library (*Ann Arbor, Michigan*) and consultant of the Jefferson Books Project at the Library of Congress has broadcast an appeal to dealers and collectors in an effort to locate books from the library of THOMAS JEFFERSON. Dr. ADAMS writes: "The Library of Congress is compiling for publication as complete a list as possible of all books ever owned by JEFFERSON, with present locations where such can be determined. You will remember that he had at least three libraries: 1, that which was almost entirely destroyed by fire in 1770; 2, that which went to re-found the Library of Congress in 1815; and 3, that which was sold at auction in 1829. A facsimile of the 1829 sale catalog has been prepared and will be sent on request to any person or institution desiring to check their collections for possible JEFFERSON books." — The identification of books owned by JEFFERSON is simple. He had a "secret mark" rather than a bookplate. It was his custom to inscribe a *T* before the signature mark *I* or *J* in all books with that many signatures, and in larger books also place a *J* after the signature mark *T*. This has been more fully described in Dr. A. S. W. ROSENBACH'S "A Book Hunter's Holiday," p. 144, and in Dr. ADAMS' "Three Americanists," p. 75.

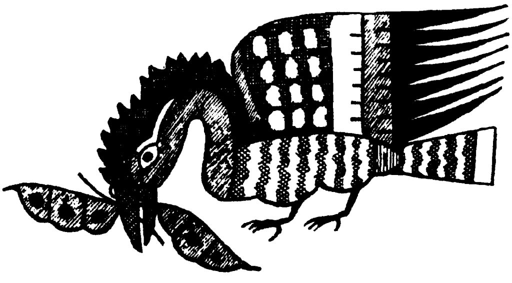
► **Antibacterial Substances in Plants:** — Mr. E. M. OSBORN'S experiments, as set out in *Brit. Journ. Exp. Path.*, 1943, afford another indication of how much remains to be known concerning plants. He has tested two thousand green plants in an endeavour to discover how many contain antibacterial substances that may prove helpful in the cure of diseases. These substances were found in sixty-three genera belonging to twenty-eight families, but their specificity and potency vary considerably. In many instances the antibacterial substances are produced by enzyme action, but they may be present only in the bark, as in *Magnolia acuminata*, or chiefly in the seeds, as in the Cabbage, while in other instances, as in *Asarum europaeum*, they may occur throughout the plant; moreover, they may be "anti" to only one of the bacteria against which they were tested. The experiments are by no means conclusive, as the inhibitory substances have been tested only against *Staphylococcus aureus* and *Bacillus coli*; nevertheless, they form a fine basis for future investigation. A list of the species tested, and the results obtained, has been deposited with the Royal Society at Burlington House, Piccadilly, London, and copies may be obtained from Sir W. DUNN, School of Experimental Pathology, *Oxford, England*.

# A PORTFOLIO *of* PLATES

## *mostly of historical interest and relating to*

# LATIN AMERICA

THE FOLLOWING FIFTEEN PLATES HAVE BEEN REPRODUCED FROM PLANTS AND PLANT SCIENCE IN LATIN AMERICA, A LARGE COOPERATIVE VOLUME, EDITED BY FRANS VERDOORN AND RECENTLY PUBLISHED AS VOLUME 16 OF A NEW SERIES OF PLANT SCIENCE BOOKS. AS SOME OF THE SUBSCRIBERS TO CHRONICA BOTANICA WILL NOT HAVE ACCESS TO THIS VOLUME, WE PRESENT HEREWITH A SELECTION OF HISTORICALLY INTERESTING ILLUSTRATIONS FROM IT. FOR A COMPLETE TABLE OF CONTENTS OF PLANTS AND PLANT SCIENCE IN LATIN AMERICA SEE OUR AUTUMN 1945 CATALOGUE, A COPY OF WHICH MAY BE FOUND AT THE END OF THE AUTUMN NUMBER OF VOLUME 9 OF CHRONICA BOTANICA.



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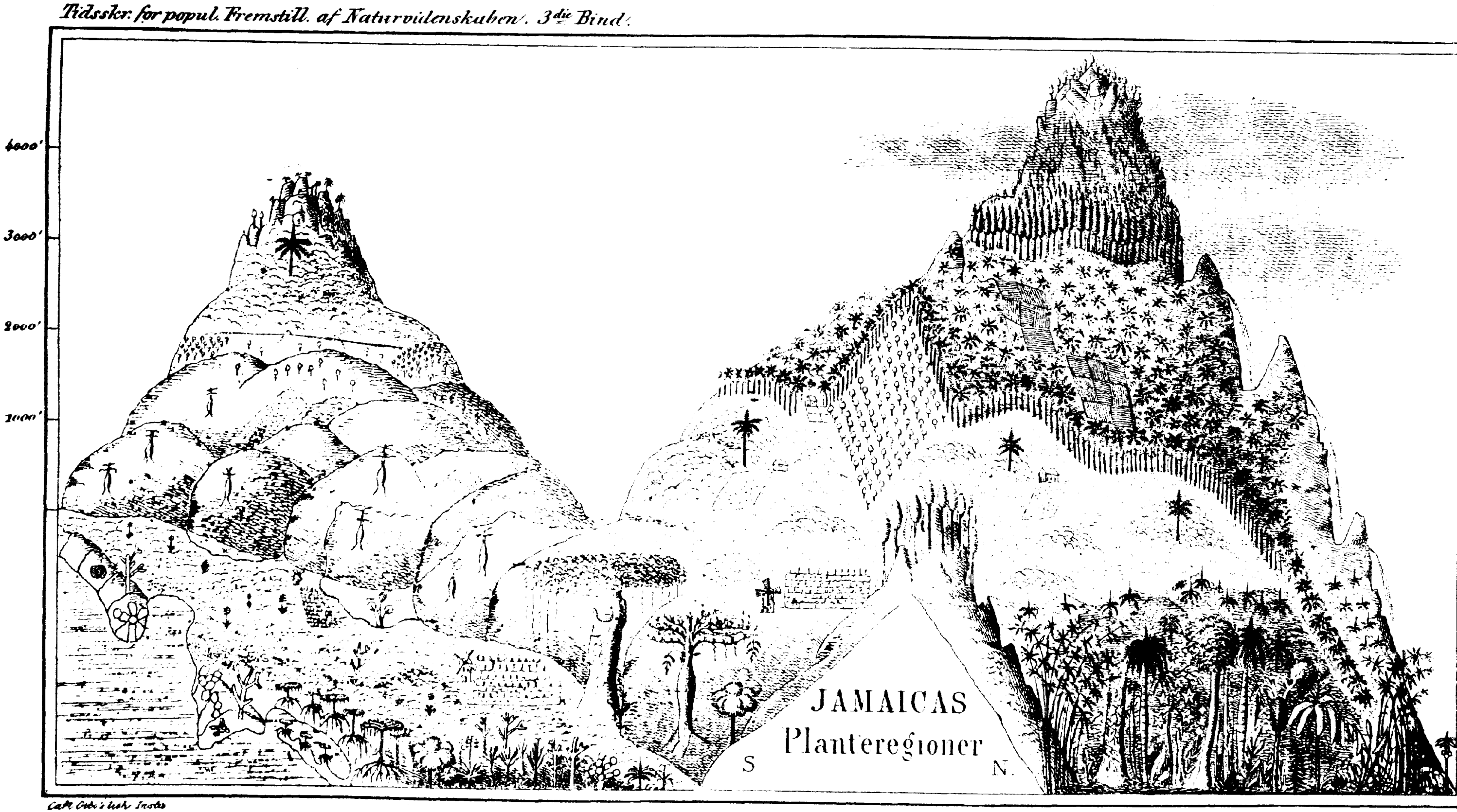


Plate 3. — An early attempt to illustrate the vegetational zones of a tropical island. — From A. S. Ørsted, "Jamaica, En Naturskildring" (1857). — *Courtesy Arnold Arboretum of Harvard University.*

PLATE 4. — "PLANTS AND BIRDS OF SURINAM." — Composition by a self-taught mulatto (ca 1811), from SACK'S "Reise nach Surinam" (1821, cf. p. xviii-xix). — *Courtesy Arnold Arboretum of Harvard University.*

PLATE 5. — *Riverine tropical rain forest.* — Tab. physiogn. I of MARTIUS' *Flora Brasiliensis* ("Silva in ripa fluvii Amazonum, Caa-ygapo dicta").

PLATE 6. — *Tropical rain-forest.* — Pl. 3 of BELLERMAN'S "Tropenbildern," Berlin, 1894 ("Laubwald aus der Quebrada de las minas bei Cumanacoa, 300'. Vorn ein grosser Stamm von *Ficus gigantea*, etwas zurück einige Stämme von *Ocotea turbacensis*. Beide sind berankt mit *Bignonien, Cissus* und *Philodendron, Sciadophyllum* und *Rhipsalis*-Arten, und bewachsen; ersterer mit *Acrosticha, Pleurothallideen* und *Anthurien*, letzterer am Grunde mit einer *Bromelie, Pitcairnia*. Im Vordergrunde links eine *Myrsinee*").

PLATE 12*a*. — *Tropical rain-forest.* — Cutting a way along a tributary of the Rio Doce. — *From* "Reise des Prinzen von Neuwied in Brasilien".

PLATE 12*b*. — *South Brazilian forest and savanna zone.* — Araucarias in the Serra-Ouro-Brancõ (Minas Gerais, Brazil). — *From* RUGENDA's "Reise in Brasilien" (1836).

PLATE 13. — *Palm forest.* — Tab. physiogn. LIV of MARTIUS' *Flora Brasiliensis* ("Fontes Fluvii Paraguay"). The palm is *Copernicia australis* (Carandá palm).

PLATE 25. — NATIVE RUBBER MANUFACTURE ON THE BANKS OF THE MADEIRA (*N. Brazil*). — *From* FRANZ KELLER, "The Amazon and Madeira Rivers," London, 1874 ("An earthen jar, without bottom and with a narrow neck, is set by way of chimney over a fire of dry urucury, or uanassú palm (*Attalea*) nuts, the smoke of which alone, strange to say, has the effect of instantly coagulating the caoutchouc sap, which, in this state, greatly resembles rich cow's milk. The workman sitting beside this 'chimney,' through which roll dense clouds of a smothering white smoke, from a small cabahash pours a little of the milk on a sort of light wooden shovel, always careful, by proper management of the latter, to distribute it evenly over the surface. Thrusting the shovel into the thick smoke over the opening of the jar, he turns it several times to and fro with great rapidity, when the milk is seen to consolidate and to take a greyish-yellow tinge. Thus he puts layer upon layer, until at last the caoutchouc on both sides of the wood has reached 2 or 3 centimeters in thickness, when he thinks the 'plancha' ready. Cutting it on one side, he takes it off the shovel and suspends it in the sun to dry.")


Plate 26. — House of a Rubber Collector on the Lower Madeira River (Brazil). — *From* Franz Keller, "The Amazon and Madeira Rivers" (London, 1874).

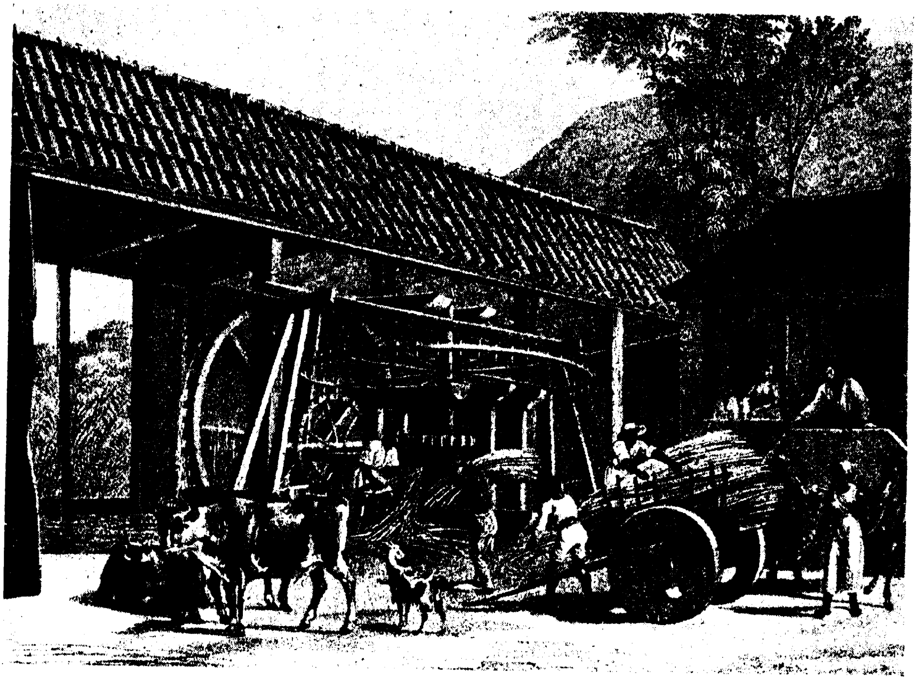

PLATE 27*a*. BRAZILIAN SUGAR MILL. *From* RUGENDA'S "Reise in Brasilien" (1836).

PLATE 27*b*. — PREPARING MANIOC (CASSAVE). — *From* RUGENDA'S "Reise in Brasilien" (1836).

PLATE 28. — ALEXANDER VON HUMBOLDT (after an engraving by F. G. WEITSCH, reproduced by courtesy of Mrs. R. A. HUNT of Pittsburgh, Pa.). — "Scientifically this expedition gave us our first clear understanding of problems of altitudinal and geographical alignment of vegetation . . . [his] figure remains permanently that of the master of philosophical observation . . ." (PENNELL, p. 40/41, pars 1 of this volume).

PLATE 31. — COFFEE PLANTATIONS IN BRAZIL IN THE EARLY 19TH CENTURY. — Plate XLIV of MARTIUS' *Flora Brasiliensis* ("in praedio inter oppidum Magé et montes Serra dos Orgãos").

PLATE 33. — TERMITE NESTS AND ANT EATERS ON A DEEPLY ERODED PLATEAU IN BRAZIL. — Tab. physiogn. III of MARTIUS' *Flora Brasiliensis* ("Arboreta in minis novis; taboleiro coberto incolis dicta").

PLATE 37. — CAMP OF A BOTANICAL COLLECTOR IN VENEZUELA (LOS CENALES). — *From* C. F. APPUN "Unter den Tropen" (1871).

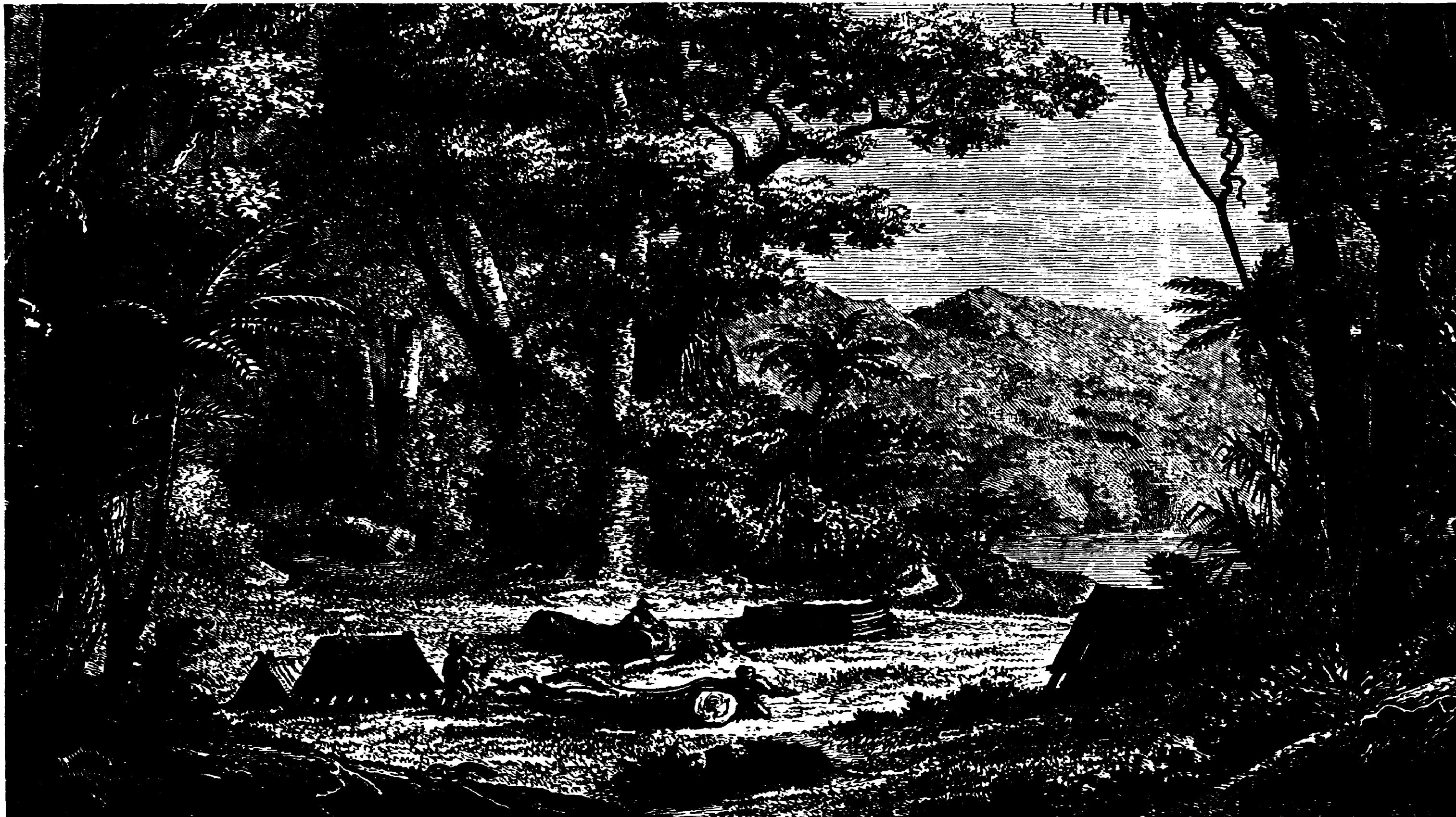

PLATE 38. — COLLECTING CINCHONA IN THE PERUVIAN FOREST. — Woodcut by LAPLANTE, after a drawing by FAGUET. — *From* FIGUIER'S "Histoire des Plantes".

# INDEX

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CONTENTS OF VOLUME I



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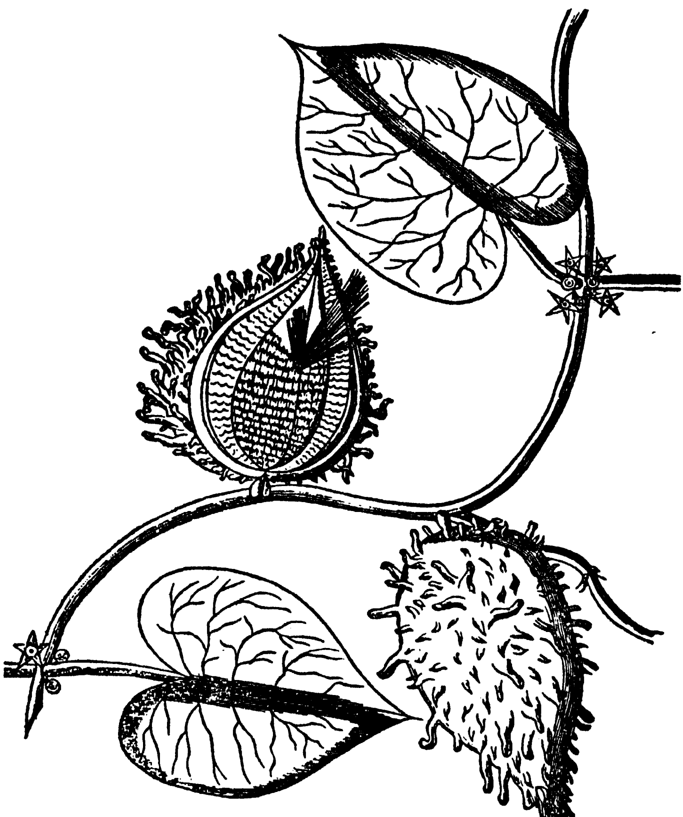

# INTERNATIONAL RELATIONS *in* SCIENCE

## *a review of their aims and methods in the past and in the future*

*by*

WALTER B. CANNON, M.D., Sc.D., LL.D.

*Chairman, Div. of Foreign Relations, National (U.S.) Research Council; Foreign Secretary, National (U.S.) Academy of Sciences; Emeritus Professor of Physiology, Harvard University; etc.*

*and*

RICHARD M. FIELD, Ph.D.

*U.S. Representative, Committee on Science and its Social Relations, Int. Council of Scientific Unions; Member, Div. of Foreign Relations, Nat. (U.S.) Research Council; Director, Summer School of Geology and Natural Resources, Princeton University.*

*In 1813, when France and England were fighting each other, Sir Humphrey Davy visited Paris, was awarded a gold medal by the* Académie des Sciences, *and elected a corresponding member. Such amenities have long since vanished. (Report of the Division of Foreign Relations, Nat. (U.S.) Research Council, 1943).*

# EDITOR'S FOREWORD

*Although parts of the following interesting report are not directly concerned with biology and agriculture, its general aspects, considerations, and conclusions are of great importance from our point of view. As soon as I had seen the original mimeographed version of Dr.* CANNON *and Dr.* FIELD'S *memorandum, I asked them for permission to publish this document, which incorporates the views and experience of so many distinguished workers, in the field of international scientific relations, in a most useful way.*

*Permission for reproduction was not only gladly given, but Dr.* RICHARD M. FIELD, *the junior author, undertook to rewrite the document entirely, and the editors of* CHRONICA BOTANICA *take great pleasure in printing this version of the report in their journal.*

*We have reported in the past in detail about most of the organizations with which this report deals, in the section "International Relations" of* CHRONICA I *seq. Now that the war is over, the future of international relations in science — their aims, scope, and possibilities — are again much in our mind (although they have of course never been out of our thoughts during the war years). In the past* CHRONICA BOTANICA *has given relatively more space to international relations in its field than probably any other scientific journal. We will continue to do so in the future and are happy to open the series of numbers of* CHRONICA BOTANICA, *devoted to the study and promotion of international relations in science in the post-war world, with Dr.* FIELD *and Dr.* CANNON'S *memorandum.*

*Extra copies of the report may be obtained, without charge, from the* CHRONICA BOTANICA CO., *Waltham, Mass., or the Division of Foreign Relations of the National (U.S.) Research Council, 2101 Constitution Avenue, Washington, D. C., or the Secretary of the International Council of Scientific Unions (Dr.* F. J. M. STRATTON, *Gonville and Caius College, Cambridge, England), or the Secretary of the International Union of Biological Sciences (Dr.* M. J. SIRKS, *University of Groningen, the Netherlands).*

## —CONTENTS—

*Part I*

# INTRODUCTION: REASONS AND AUTHORITY FOR THE MEMORANDUM, INCLUDING THE METHODS USED IN OBTAINING THE ESSENTIAL DATA

**Introduction:** — This Memorandum has been prepared for the Division of Foreign Relations of the National Research Council. Copies have been requested by the Division of International Conferences of the United States Department of State, by non-American officers of the "Unions", and by other agencies concerned with the international aspects of science, technology, and their social relations, including the International Council of Scientific Unions. This Memorandum will not attempt to define science, or scientific method, except in terms of the seven existing technical divisions of the National Research Council of the United States, and the interrelation of their problems with those of the Division of Foreign Relations. These seven technical divisions of the National Research Council are: Division of Physical Sciences, Division of Engineering and Industrial Research, Division of Chemistry and Chemical Technology, Division of Geology and Geography, Division of Medical Sciences, Division of Biology and Agriculture, and Division of Anthropology and Psychology. If economics and politics are not recognized in this Memorandum as sciences, it is because they are not so recognized by the National Research Council of the United States nor by any National Committee of any international scientific union. The implications, however, of the responsibilities of scientists to society are suggested not only in the general organization of the N. R. C., but also by the American representative of the Committee on Science and its Social Relations of the International Council of Scientific Unions. It should also be noted that American officers of International Scientific Unions represent their Unions in the Division of Foreign Relations. The ultimate authority for the preparation of this Memorandum is through the Division of Foreign Relations of the United States National Research Council according to paragraphs 3, 4, and 6 of the Executive Order No. 2859, May 11, 1918. (*See* p. 284.)

This Memorandum is in no way directly connected with science and the winning of the war; it is, however, concerned with science and the winning of the peace. For quite obvious reasons no truly international organization has been, or ever could be, created for winning wars. We are not aware of the full degree of Axis effort and efficiency in scientific coöperation for winning the war. We are aware of our own national scientific organizations and British organizations, including their coöperation, for the same purpose. The Division of Foreign Relations of the National Research Council is particularly concerned, because of its full responsibilities, in any and all scientific and technological contributions to winning and maintaining

a reasonable comity among nations, including the about-to-be-liberated areas and those of their defeated invaders.

War is a great stimulus to national, and to limited international, coöperative scientific research in most, if not all, of the applied sciences. On the other hand, this stimulus though greatly increasing scientific effort necessarily has uneconomic, unsocial and inhumane implications. It is only in times of relative peace between nations that the fundamental and cumulative effects of the impact of science and technology on human society can be studied by the scientific method, without interference of ideological propaganda and wishful thinking associated with war time economics and war time politics. Similar, though less intense, restrictions interfere even in times of peace with the complete interchange of scientific techniques for the benefit of the people of all nations. These restrictions, therefore, also tend to interfere in all international scientific and technological gatherings, particularly when the scientific personnel act primarily as delegates of their national institutions rather than as scientists representative of their countrymen. Only continuous effort will accelerate international coöperation in fundamental science, or in scientific research beneficial to all men, and inimical to none.

This Memorandum is, therefore, concerned with the continuity of international coöperative research, and particularly with the accomplishments of international scientific organizations during the rise and fall of the Treaty of Versailles and its geopolitical implement, the League of Nations. It is significant that during this period, 1918 to 1939, excellent machinery was developed for the comity of nations through science. This machinery was sponsored by forty-two nations, including all the present belligerents, neutrals and invaded countries with the exception of Russia, and, at times, of Italy. It should be further noted that at no time were the scientific representatives of the United States in any way seriously embarrassed in their deliberations or responsibilities by the fact that their country had helped to plan the League of Nations but refused to join it.

"What we need to-day, then, is fundamentally *an attempt to combine the methods which the world of science has spontaneously worked out for itself in periods of peace, with those which the nations have had to work out under the stress of war.* The methods of peace time have included the periodical International Congresses in the various sciences, at which numerous lectures and demonstrations are given; and the International Unions or permanent Bureaux which function continuously in some sciences. The methods of war time involve the Science Coöperation Offices which have been established in both World Wars in London, Washington, Paris, Chungking, etc. None of this machinery ought to be scrapped. The problem is to weld it into a satisfactory functioning system." (JOSEPH NEEDHAM, December, 1944.)

The question may be posed as to the advisability of the scientists of the world experimenting with international organizations, or participating in international scientific meetings which are not initiated by one or more governments, but by the scientists themselves.

The Russian government is the only great power which appears to have carefully considered the importance of this question, and for reasons which are worth immediate and careful attention by American and British scientists and by their national institutions. (*See* p. 285.)

The least sporadic and opportunist of international scientific organizations have been the congresses and unions; of the two the congresses are the older. The history of international congresses, committees, and other forms of organized international coöperation goes back to the second half of the last century. *It is essential that those scientists who are today (either independently or as advisers to their governments) planning post-war research and education become familiar with previous efforts in their field and related fields. They should do this in order that they may evaluate the past experience of others before attempting to define the frame work of new or duplicating organizations.*

Certain departments of science and technology are represented by the congresses, and others by the unions; but some departments of science are represented by both congresses and unions. For instance, in the case of the biological sciences, the Union and the Congress are closely related; in the case of the earth sciences, the International Union of Geodesy and Geophysics overlaps particularly the functions of the International Geological Congress; but there has been no particular liaison between these international organizations either as to agenda or meetings, except through a commission of the International Union of Geodesy and Geophysics.

The scientific congresses do not function between meetings, and, at times, are more subject to political opportunism, as in the case of the last or Eighth American Scientific Congress. The mechanism of the International Scientific Unions include *Bureaux* which are expected to function continuously between meetings; and the Unions are financed by all countries which adhere to one, or more, of them. The control of each Union, however, is through its Bureau: whose officers are elected at a General International Assembly. Each International Scientific Union also has its national committees which represent the affairs of each Union on a National Research Council, National Academy, National Society, or analogous National Scientific Council. Finally, there is an International Council of Scientific Unions whose primary function is the coordination of all science particularly for the promotion of international friendship through competitive but sympathetic coöperation.

In April, 1937, the Committee on Science and its Social Relations (C. S. S. R.) was created "pour étudier le progrès, les répercussions et les nouvelles directions dans les sciences mécaniques, physiques, chimiques et biologiques, tout spécialement dans le but de dresser un tableau de la pensée humaine en ce qui concerne le développement du panorama scientifique mondial, *et la signification sociale des applications de la science.*"

The last report (1939) of the Council of International Scientific Unions was through its Committee on Science and its Social Relations. This report consists of the original data supplied by each national representative of the I. C. S. U. Unfortunately, the United States never submitted its report. Of particular significance at the present time (1944) are the reports from Poland, Estonia, Latvia, Canada, and Great Britain.

This digest of the organizations, methods, and activities of the international scientific unions is predicated on the assumption that any adverse criticism is probably equally, if not more, applicable to other existing national and quasi-international organizations.

Dependent upon the character, rather than upon the profession, of their officers certain of the International Unions have been more effective than others. On the whole, however, the activities of the International Scientific Unions from 1918 to 1945 warrant the recent statement by an executive officer of one of America's leading technical, social, and philanthropic organizations: "If there is any nucleus of international goodwill and understanding left in the world, it resides, I think, in scientific personnel. They will be the first to mend the broken wires of communication, and I hope this time all the world will realize, whether we like it or not, we have to live together on a globe which science has made too small for war." (T. B. Appleget, July 11, 1944).

At the April meeting of the Executive Committee of the Division of Foreign Relations, 1943, there was some discussion of the war time activities of the International Scientific Unions. This discussion was precipitated by the difference in the reports of the American officers and their adjutants. The relative activity or inactivity of each American officer did not seem to be conditioned entirely by the department of science which his union represented nor by the fact that he and his colleagues were particularly burdened by their contributions to the war effort. After some informal discussion it was decided to circularize all available officers, or adjutants, of the International Scientific Unions and International Scientific Congresses. This was done in the form of a questionnaire which was finally formulated by three members of the Executive Committee, Division of Foreign Relations, N. R. C., and jointly transmitted by the Chairman of the Division of Foreign Relations and the N. R. C. representative of the Committee on Science and its Social Relations, International Council of Scientific Unions. This questionnaire was issued during the last week in March, 1944.

**Questions:—**

I. To what extent has there been interchange of information in your field between your country and foreign countries, other than for war purposes, during the past two years? By:

1. Officers and personnel of your International Scientific Union (Congress or Society).
2. National societies.
3. National educational and research organizations.
4. Personal correspondence.

II. Are members of your Union (Congress or Society) planning an international meeting as soon as world conditions will permit?

1. If so: Why and where?
2. If not: Why not?

III. If your Union (Congress or Society) through its national committees or commissions is still active, do your activities include:

1. Interim reports.
2. Preparation for resumption of your international journal or transactions.
3. Continued government financing through one, or more, of the national committees.
4. Plans for international interchange of technical publications with the allied and neutral countries. Also, plans for interchange with axis occupied countries after the war.

IV. Have the officers of your Union (Congress or Society) kept in touch with the officers and personnel of other Unions (Congresses)? If so, with which countries, and what was the nature or general purpose of the correspondence?

V. Are there specific scientific projects, requiring international cooperation, in which your Union (Congress or Society) could participate, with essentially equal advantage to all cooperating countries?

VI. Does your experience lead you to believe that post-war international cooperation in science and education could best be served by other organizations than international scientific Unions or Congresses. If so, why?

*Part II*

## SCOPE AND AREA OF THE REPLIES TO THE QUESTIONNAIRE

I. **International Union of Pure and Applied Physics.** — According to L. P. EISENHART, Chairman, Division of Physical Sciences, N. R. C., and Representative, American Section of the Union, Division of Foreign Relations, N. R. C.: "No international activities of the 'Union' to report." (April 25, 1944). The latest information regarding the activities of the Bureau is contained in a letter from M. SIEGBAHN to the Executive Secretary, N. R. C. (Oct. 3, 1941). The following international scientific organizations may be classified with (related to) applied physics or engineering:

A. **International Bureau of Weights and Measures.** — According to L. J. BRIGGS, Representative, American Section I. B. W. M. Also some information which, for political reasons, cannot be quoted.

B. **International Electrical Commission: International Commission on Illumination.** — According to E. C. CRITTENDEN, Representative, American National Committee I. E. C. and I. C. I.

C. **International Scientific Radio Union.** — According to J. H. DELLINGER, Chairman, American Section, I. S. R. U. Also further information by others, marked 'restricted', and, therefore, may not be quoted for war reasons.

D. **International Mathematical Congress.** — According to R. G. D. RICHARDSON, Secretary.

II. **International Union of Chemistry.** — According to M. T. BOGERT, President.

III. **International Union of Biological Sciences.** — According to E. D. MERRILL, President. Also related:

A. **International Paleontological Union.** — According to B. F. HOWELL, Secretary. Also, E. DORF, Chairman, Committee on Paleobotany, N. R. C. Also, G. L. JEPSPN, Section on Paleontology, N. R. C.

B. **Botanical Section, I. U. B. S.** — According to F. VERDOORN, Hon. Secretary.

C. **International Medical Organizations.** — According to W. B. CANNON, Chairman, Division of Foreign Relations, and Foreign Secretary, U. S. National Academy of Sciences.

D. **International Aspects of Horticulture.** — According to American Horticultural Union, E. L. D. SEYMOUR, Vice President.

IV. **International Geographical Union.** — According to C. F. ARDEN-CLOSE, First Vice President. Also, J. K. WRIGHT, Chairman, U. S. Nat. Com. I. G. U.

V. **International Geological Congress** (There is no international geological union). — According to W. F. T. MCLINTOCK, General Secretary, I. G. C., R. M. FIELD, Foreign Correspondent, Geological Society of London, C. H. BEHRE, Secretary, Society of Economic Geologists, and I. H. CRAM, President, American Association of Petroleum Geologists.

VI. **International Union of Geodesy and Geophysics.** — According to H. ST. J. WINTERBOTHAM, General Secretary, I. U. G. G.; J. A. FLEMING, Vice President, I. U. G. G. and General Secretary, American Section, I. U. G. G. Also, N. J. OGILVIE, Canadian National Committee, I. U. G. G., and R. M. FIELD, Chairman, Central Commission on Continental and Oceanic Structure, I. U. G. G.

A. **International Association of Geodesy.** — According to W. D. LAMBERT, Vice President and acting President.

B. **International Association of Seismology.** — According to N. H. HECK, President, and J. B. MACELWANE, Chairman, American National Committee, Pacific Seismology.

C. **International Association of Meteorology.** — According to S. CHAPMAN, President.

D. **International Association of Magnetism (Geomagnetism) and Electricity.** — According to J. A. FLEMING, President, and S. CHAPMAN, Vice President.

E. **International Association of Oceanography.** — According to P. C. WHITNEY and T. G. THOMPSON, N. R. C. Representatives, Division of Foreign Relations. See also Committee on Continental and Oceanic Structure, I. U. G. G.

F. **International Association of Vulcanology (also Volcanology).** — According to J. A. JAGGAR, Vice President, and J. E. RICHEY, Emergency President. See also Committee on Continental and Oceanic Structure, I. U. G. G.

G. **International Association of Scientific Hydrology.** — According to O. LÜTSCHG, President (O. E. MEINZER, U. S. Representative).

H. **International Commission on Snow and Glaciers.** — (I. A. S. H.) According to J. E. CHURCH, President.

I. **International Commission on Subterranean Water.** — (I. A. S. H.) According to J. E. CHURCH, President.

J. **International Commission on Continental and Oceanic Structure.** — (I. U. G. G.) According to R. M. FIELD, President, and J. A. FLEMING, Secretary.

VII. **International Astronomical Union.** — According to A. EDDINGTON, President; W. S. ADAMS, Secretary; and J. STEBBINS, Chairman, American Section, I. A. U. Also, Committee on Distribution Astronomical Literature, A. A. U., B. J. BOK, Chairman.

VIII. **International Congress of Psychology.** — (Psychology has no international union). According to H. S. LANGFELD, Secrétaire Adjoint.

IX. **Eighth American Scientific Congress** (1939). (21 American Republics). — Review as of 1944. According to A. WETMORE, Secretary; and W. KELCHNER, Chief, Division of International Conferences, U. S. Department of State, and:

A. **Section on Physical and Chemical Sciences.** — According to L. J. BRIGGS, Chairman. (Restricted.)

B. **Section on Geological Sciences.** — According to T. W. VAUGHAN, Chairman.

C. **Section on Public Health and Medicine.** — According to T. PARRAN, Chairman.

D. **Section on International Scientific Exchange.** — C. H. HARING, Chairman.

E. **Section on Economics and Sociology.** — H. G. MOULTON, Chairman.

F. **Section on Agriculture and Conservation.** — H. H. BENNETT, Chairman.

G. **Section on Biological Sciences.** — E. G. CONKLIN, Chairman.

H. **Section on History and Geography.** — According to P. E. JAMES, Chairman.

I. **Section on Anthropological Sciences.** — According to H. J. SPINDEN, Chairman.

J. **Section on International Law and Jurisprudence.** — G. A. FINCH, Secretary.

K. **Section on Education.** — According to N. M. BUTLER, Chairman.

X. **International Scientific Organizations.** — According to W. G. LELAND, Chairman, Advisory Committee on Cultural Relations, U. S. Department of State.

XI. **International Conferences on Intellectual Coöperation.** — Havana (1941). — A. RAESTAD and A. V. HILL, Secretary, Royal Society of London.

XII. **International Publications.** — By F. VERDOORN, Hon. Secretary, Botanical Section of the International Union of the Biological Sciences.

*Part III*

# DIGEST OF THE REPLIES TO THE QUESTIONNAIRE

The following digest is intended as factual, rather than interpretative. For reasons stated on p. 255, the social sciences, as such, are not here explored. Since we are dealing with the written opinions of scientists on science rather than merely the descriptions of scientific apparatus and techniques, we may not all agree as to what is factual. This digest is, therefore, set up for future criticism by direct comparison with the documented data. It should be added that certain data have not been included in this Memorandum not because they are inconsequential, but because they are perhaps too personal, or too confidential for this Memorandum until they have been reconsidered by the reporters themselves in terms of this essentially comparative analysis.

To begin with, we may divide the digest into the following subdivisions:

A. *The extra-terrestrial sciences,* such as astronomy and cosmogony. An important connecting terrestrial link of astronomy may be found in the study of cosmic terrestrial relationships, especially of the earth, sun, and moon; also a branch of geophysics.

B. *The terrestrial or geosciences.* Composed of the decidedly overlapping departments of biology, geography, geology, and geophysics, together with their almost innumerable subdivisions and their consequent applications.

C. *The primary sciences.* Mathematics, chemistry and physics, or physical chemistry, and their many subdivisions and applications, including geochemistry and geophysics, which also overlap A and B.

This particular arbitrary classification of the sciences is in terms of the interrelations of the different recognized departments of science and of the professional classifications of the scientists.

A. **International Astronomical Union.** — Astronomy is not represented as such by a division of the National Research Council of the United States.

I. There has been considerable correspondence, during the war, between the executive officers of the Union. Because of continuing activities both Great Britain and the United States have adhered to the Union by paying their subscriptions. Previous to 1929 forty nations adhered to the Union.

II. The next international meeting of the Union will be held at the earliest opportunity. The last meeting (1941) was scheduled for Zurich, Switzerland. It has been suggested by the Bureau that the first post-war meeting might be held in the United States.

III. No interim reports during the war. The Union has no international journal.

IV. Some contacts with officers of other Unions, particularly Geodesy and Geophysics, but largely for business reasons.

V. Of the large number of international projects several have been kept going by payment of grants through neutral countries.

VI. Astronomers, as a whole, approve of the Union and consider it a most effective organization for active coöperation of the world's astronomers. The Royal Astronomical Society recently passed a resolution urging continuance of I. A. U.

"The new Chairman of the American Section of the I. A. U. is HARLOW SHAPLEY who, as President of the American Astronomical Society, will also act as Chairman of the Section when it becomes active again." (J. STEBBINS, Aug. 16, 1944.)

## B. Geoscience.

a. **International Union of Biological Sciences (including Botanical Section).** — Biology is represented on the U. S. National Research Council by the Division of Biology and Agriculture.

I. With the exception of Latin America, there has been little contact between the officers of the Union since most of them are in Axis occupied territory and in Switzerland.

II. It is planned to hold a meeting of the Union in Sweden as soon as possible at the time of the 7th International Botanical Congress. The principal efforts at international intercommunication during the war are in the Botanical Section, whose Secretary is a Netherlands' expatriate now residing in the United States and close to the President of the Union.

III. Some commissions are still active but rather through individual than coöperative efforts.

IV. There are many projects requiring international coöperation.

V. The Botanical Secretary is now compiling a list of all international plant science organizations (ca. 70) and expects to report their current activities and post-war plans in the course of 1946.

VI. No comments as to desirability of post-war continuation of the Union as a whole, except for statement under II.

b. **Proposed American Horticultural Union.** — Of significance to this Memorandum because of its recognition of the international interrelation of science, education, arts, professions, humanities, amateurs (non-professionals) and business. Also of significance in any consideration of the post-war modification, or reorganization of the National Research Council of the United States.

I. There exists no International Horticultural Union. Following the 11th International Horticultural Congress held in Rome in 1935, there was discussed desirability of founding an International Horticultural Bureau. Later, while this discussion was still in progress, it was announced that the International Institute at Rome had decided to add to its organization a "horticultural section" to take the place of the projected bureau. Apparently nothing was actually accomplished in this direction prior to the opening of World War II (see *Chronica Botanica,* Volume IV, 1938, pp. 197-204). Consequently, the only international exchange of horticultural information (as mentioned above) has been either (*1*) between the U. S. Department of Agriculture and corresponding governmental agencies of other countries; (*2*) between various organizations, such as horticultural societies, garden clubs, special flower societies, trade groups, etc.; (*3*) between scientific institutions, such as botanical gardens, arboreta, colleges, experiment stations, etc.; or (*4*) between individuals and individual horticultural establishments such as nurseries, seed firms, etc. In no case could such interchange be considered "official" in the sense that it has been conducted by any group or agency delegated and authorized to represent and speak for all horticultural interests of the United States. Even at the various International Horticultural Congresses held from time to time prior to 1938, the United States was represented only by a member or members of the United States Department of Agriculture, appearing, of course, only on behalf of that agency.

II. For many years there have been frequent recurrences of a conviction on the part of different individuals that (*1*) the United States should have one overall group, council or other organization that could effectively represent all the interests and activities embraced in the field of horticulture; (*2*) *such an organization could and*

*should be part of an international body through which horticultural knowledge could be exchanged between the countries of the world, with a view to making its benefits available to all mankind.*

Within the past year this conviction, and its informal discussion, has resulted in the proposal that there be formed an American Horticultural Union, patterned in some respects after the existing unions of various scientific interests. This proposal is based on the following beliefs: (*1*) That horticulture which has been defined by Dr. L. H. BAILEY as "the growing of flowers, fruits and vegetables and of plants for ornament and fancy" has not been as generally or fully appreciated as have the other closely related phases of the broad inclusive field of agriculture. (*2*) That the fundamental significance and potential benefit of horticulture to mankind as a constructive force in the promotion of national and international well-being have not been realized and are not being fully developed. (*3*) That there is a close and mutually advantageous relation between horticulture and the other arts and sciences that also has not been fully realized or utilized as a basic factor in the attainment of human welfare and social progress. ("Primarily, horticulture is an art, but it is intimately connected with science at every point." — L. H. BAILEY) (*4*) That there exists in America at this time an exceptional opportunity to initiate and foster such recognition, appreciation and promotion. The United States, with its broadly representative range of terrain, climate and other factors that influence and govern plant growth, provides an illustration or demonstration of the principles of horticulture, greater than that offered by any other continuous land area in the world, with the possible exception of post-war Russia. Furthermore, American horticulture and horticulturists, because of their exceedingly favored situation, have before them an enviable opportunity and a definite responsibility to contribute in generous measure to the resources and leadership needed for a successful renewal of attempts to promote closer, more effective international relations in this field.

III. To date, the discussion of this proposal has focused upon the formation of a Horticultural Union which would include *membership sections* for the following classes of horticultural interests: (*1*) Scientific and Educational; (*2*) Professional, including the various arts and humanities concerned; (*3*) Amateur; (*4*) Commercial; and would include among its *objectives*: (*1*) The stimulation and promotion of horticultural research and teaching; (*2*) the fostering of a better understanding between them and all related fields of interests; (*3*) the inspiration and development in the public mind of a recognition of the importance of horticulture in its relation to the well being, culture and happiness of all people; (*4*) the adequate representation of horticulture both in American affairs and in international relations. To realize the last mentioned objective (*4*), such a Union is organized; to become affiliated with the existing International Union of Biological Sciences through the latter's American section; and, ultimately, through its own section for science and education, to coöperate, or become affiliated, with the National Research Council.

IV. It is the profound conviction of those interested in the formation of an American Horticultural Union (and, they hope, the formation in due course, of a corresponding international organization) that there are *many* projects — of scientific, social and popular character — which could be carried forward jointly by horticultural unions in the various countries with mutual benefit to the participating countries and their peoples, and, indeed, to the benefit of the world in general. Much thought is being given to the post-war problem of the building of a more stable world structure. It seems fitting, therefore, to consider the claims and potentialities of horticulture as a common denominator of human interests of many types, applicable in virtually all parts of the world, and practiced to some degree by all elements of society; as a subject whose enthusiasts include amateurs, professionals, commercial workers and scientists; as (to quote again Dr. L. H. BAILEY) "a composite of botanical and agricultural subjects" and "a means of expressing the art sense"; as a range of human activities that reaches above, and is free from and untrammelled by the prejudices, complications and entanglements of political and economic relations. Such consideration is directly in line with the first duty of the National Research Council as set forth in President WILSON's Executive order of May 11, 1918: *viz.*, "In general, to stimulate research in the . . . sciences

human distress and the prevention of disease and premature death — unites them in a fraternity which disregards differences of race and nation. Disease does not respect artificial boundaries. And the spread of infection may be world wide, as was true of influenza in 1918. It seems probable that the establishment of collaborative enterprises after the war will be easier for international medical organizations than for many other groups engaged in scientific or technical activities." (W. B. CANNON, Sept. 8, 1944.)

e. **International Congress of Psychology.** — Psychology is represented on the United States National Research Council by the Division of Anthropology and Psychology.

I. No international exchange of information, other than for war purposes during the last two years.

II. Last congress was to have been held at Edinburg. The Assoc. Secretary (American) now in correspondence with the British as to time and place of next congress.

III. Inactive during war, due to impossibility of correspondence with majority of committee.

IV. *See* II.

V. Numerous projects in social psychology and anthropology require international coöperative research.

VI. Congress has been successful, but should be supplemented by coöperation between national associations of the various countries (such as is accomplished by an International Union). British psychologists "are of the opinion that we should hold the next Congress as soon as possible after the war."

f. **Archaeology.** — Apparently has no international Congress or Union, but included in this Memorandum because of its international importance as an agent in the comity of nations. Requires complete coöperation of specialists in Geology, Geophysics, Anthropology, Geography, Chemistry, and Biology.

At the request of the Division of Foreign Relations, N. R. C., Dr. C. R. MOREY has prepared the following statement relative to the national and international organization of archaeology: "National or international organizations of archaeology are the worst organized of any so far as I can see. We have a half dozen national societies that are interested in archaeology and the history of art with no system of coöperation, and so far as international unions or congresses on the general subject of archaeology are concerned, nothing of the sort exists. The need of such international coöperation has been obvious for some time. For example, an international union or a periodic international congress could do something about alleviating the strict law of export of antiquities that now inhibit the progress of excavating in Italy, Greece and some places in the Near East. Another advantage of such an international union or congress would be the detection and tracing of forgeries. Still another would be the bringing together of the various disciplines that can be listed under the head of archaeology and correcting the discrepancies in research that now result from too much departmentalization. One instance of the last named trouble is the fact that the theory of the evolution of Mediaeval Art in the United States is in many important respects quite divergent from that in Europe owing to the lack of exchange of ideas and publication." (Dec. 1, 1944.)

g. **International Geographical Union.** — Geography is represented on the U. S. National Research Council by the Division of Geology and Geography.

I. There has been no interchange of information between officers of the Union, including British and American, during last two years. One result has been a lapse of payments by both British and American Governments.

II. No plans for next meeting of the Union.
III. No activities since the war.
IV. Officers of the Union have not kept in touch with the officers and personnel of other Unions.
V. The chief scientific project in which the Union could participate is to stimulate production of the Carte du Monde au Millionième.
VI. The only real advantage of the Union seems to be the monetary assistance provided by the adhering governments. Suggested that the geographers revert to old system under which the principal geographical societies arranged between themselves for international gatherings and coöperation generally.

h. **International Geological Congress.** — Geology is represented on the National Research Council by the Division of Geology and Geography.

I. The XVIIIth Congress was to have been held in London, July, 1940. A balance of funds is now in custody of Geological Society of London pending any decision as to time and place of the next meeting.
II. Officers of the Congress are not particularly in touch with each other except through the Geological Society of London, and the Commission on Continental and Oceanic Structure, I. U. G. G.
II. The General Secretary reports "nothing doing at present."
IV. Officers of the Congress are not in touch with other Unions except through the "Commission" of the I. U. G. G.
V. There are no projects requiring international coöperation, as stated by General Secretary. See also statement by "Commission", I. U. G. G. (p. 276j).
VI. *See* I.

i. **Society of Economic Geologists.** — At the request of the Division of Foreign Relations, N. R. C., the Chairman of the Division of Geology and Geography, N. R. C., W. W. RUBEY, inquired of all "American" geological organizations as to their international affiliations and activities. The reply of Dr. C. H. BEHRE, JR., is here quoted in full.

"In contrast with the other strictly geological societies with headquarters in the United States, the Society of Economic Geologists has at least undertaken to be essentially *international* rather than *national* in membership, and to some though lesser degree in administration. This is indicated by its name, which does not include the term American; by its seal, which shows both hemispheres; and by its By-Laws which expressly state:

Article 2. . . . the Society's *international* character and scope . . . .
Article 4. . . . The regional officers shall consist of six *Regional* Vice-Presidents, *one from each of the continents* . . . .

Of the total membership of 464 as of 1943, 293 were from the Continental United States and four from the Philippine Islands. The rest, almost exactly 36 percent of the regular membership, were from "foreign" countries. Yet there is no specific ratio of American to "foreign" membership. The headquarters, however, and the majority of the officers are American.
I. 1. At least 5 of our 6 Regional Vice-Presidents are necessarily not residents in the United States or its territories. In the average year 1 of the 9 Councilors is from Canada and the President or Vice-President may be a Canadian. In its twenty-two administrations, the Society has had two major officers from Europe — a President from Germany and a First Vice-President from Sweden. — 2. There have been no communications with other national societies of other countries in any official manner.—3. Ditto, with respect to the national educational and research organizations of other countries. — 4. There is considerable personal correspondence between this office and other members of the Society situated in this country, on the one hand, and "foreign" members of our Society, on the other. Such correspondence deals with publications,

membership matters, research undertakings here or abroad, advice to "foreign" or American students, and procurement of publications.

II. Our Society has not contemplated an international meeting "as soon as world conditions permit", as distinct from its usual meetings. I should remark further that, as our meetings have invariably been in the United States (with the exception of one or two meetings and one or two field excursions in Canada) the international character of our meetings is not as successfully maintained as is desirable, in my opinion. This generally "American" tone at our meetings results, I believe, from the fact that the main administration and the larger proportion of the members are in this country. However, it would seem difficult for our relatively small and impecunious society to organize meetings elsewhere than in the United States or perhaps in Canada, though such meetings would certainly be possible undertakings. I believe that the membership would generally be of the opinion that the International Geological Congress (held, as you know, every third or fourth year in successively differing countries) and the various meetings of national geological and mining societies outside the United States afford adequate opportunities for international association without the large labor and expense involved in an additional international organization representing our Society.

III. 1. We issue no interim reports. However, we still publish regular, essentially monthly reports in our journal ("Economic Geology") and transmit these to all of our members to the extent to which government can permit international communication during the war. This practice has never been discontinued. In fact, it has, if anything, been appreciably *increased* since the beginning of the present war, and the most complete issue of our triennial "Proceedings" was published in 1943 and distributed to all our members, abroad and here, who could be reached by mail. — 2. Our international journal and transactions have been published throughout the war, much as usual. — 3. Government financing is not involved in our work. — 4. It is assumed that our relation with all foreign countries, including Axis-occupied countries, will be resumed after the war until it at least equals that prevailing before 1939. Even at present articles are submitted by non-American writers and are published on the same basis as those submitted by American writers. So far there has been no indication that any distinction in our attitude will be made after the war between the treatment of citizens of Axis-occupied countries or Axis countries on the one hand and those of friendly nations or of the United States on the other.

IV. The officers of our Society have not specifically kept in touch with the officers and personnel of other societies in the sense in which I read this question. In view of their accessibility and their similar problems, close coöperation exists, of course, between our Society and the other geological societies of the United States (especially the American Association of Petroleum Geologists, the Geological Society of America, the American Institute of Mining and Metallurgical Engineers, and to a lesser degree the American Geophysical Union. Moreover, several of our non-American members are also members of foreign geological societies and thus serve to link us with similar organizations elsewhere.

V. It is not an official opinion, but solely my personal impression that our Society could serve as a strong force in the following projects that are of great international importance to scientists in the fields represented by our Society:

A. New geologic mapping, and especially the assembling of what is already known about the geology of "backward" regions where geologic surveys do not function in their own right. This applies to much of Africa, much of South and Central America, much of eastern and southeastern Asia, and even to part of Mexico.

By systematic effort such work could be especially advanced by our Society because of our relative preponderance of mining geologists and (to a lesser degree) petroleum geologists, members of the Society, who are called to work in such little known areas.

B. The entire field of geochemistry as applied to deposition of ores and other useful mineral products could be coordinated and furthered by our Society.

C. Much basic work in applied ground-water geology and engineering geology. This could be stimulated by our Society and effectively distributed by publication in "Economic Geology".

D. The "Annotated Bibliography of Economic Geology", which undertakes to cover articles published in all languages and all countries, dealing with the subject of economic geology in its broadest sense, could well be made more effective as to coverage if the aid of non-American bibliographers could be enlisted in its compilation.

I am particularly glad that this question was asked, as it seems to me that our Society has failed to live up to its possibilities in the respects enumerated above. Probably other members of our Society could suggest at least an equal number of forms of international coöperation in scientific research.

VI. In my opinion (rather than in my experience, for my experience in international coöperation is very limited), the most effective plan for post-war efforts of the sort referred to would be for international unions or congresses to serve as coordinating agencies, operating largely through local societies. I am not certain that our own Society could go very far in initiating or furthering coöperation on an international scale of the type mentioned because of the limited funds available to it. It could suggest them and initiate them. More strictly national societies could carry them out within each country. The International Geological Congress, if *active,* could stimulate and correlate such work. In the past we have not shown great interest in this problem; perhaps in the future we may do so!" (Feb. 12, 1945.) *See also* American Association of Petroleum Geologists (B. ii).

ii. **The American Association of Petroleum Geologists.** — The reply of I. H. Cram, President (1945) is also quoted in full.

"The Association (and its 25 affiliated geological and geophysical organizations is the largest geological organization in the world, and although most of the members reside in the United States, the *membership is in fact international.* As the search for oil becomes more worldwide, more Association members will work in foreign countries. In the field of petroleum geology there is no rival organization. Recently the executive committee has taken steps to acquire and publish in the *Bulletin* and in special volumes more information on the petroleum geology of the world outside of the United States. Practically all of this material will be contributed by members. As we publish more foreign information, more foreign geologists will be attracted to membership in the Association. It is therefore my view that we as an Association are accomplishing at least in part the international coöperation desired." (I. H. Cram, Feb. 15, 1944.)

The Association has approximately 340 foreign members from 41 different countries, distributed as follows:

| | | | | | |
|---|---|---|---|---|---|
| Angola | 1 | Dominican Republic | 4 | Nicaragua | 2 |
| Argentina | 19 | Ecuador | 15 | Palestine | 2 |
| Australia | 9 | Egypt | 3 | Persian Gulf | 3 |
| Barbados | 1 | England | 14 | Peru | 5 |
| Belgian Congo | 1 | Germany | 1 | Portugal | 1 |
| Bolivia | 1 | Haiti | 2 | Scotland | 2 |
| Brazil | 2 | India | 2 | Sumatra | 2 |
| British Guiana | 1 | Iran | 1 | Switzerland | 9 |
| Canada | 58 | Iraq | 1 | Syria | 1 |
| Chile | 6 | Japan | 1 | Trinidad | 20 |
| China | 1 | Java | 1 | Turkey | 1 |
| Colombia | 45 | Mexico | 16 | Uruguay | 1 |
| Costa Rica | 1 | Netherlands | 1 | Venezuela | 70 |
| Cuba | 8 | New Zealand | 5 | | |

j. **International Union of Geodesy and Geophysics.** — Geodesy and geophysics are represented on the U. S. National Research Council by the Executive Committee of the American Geophysical Union. The

Executive Committee of the A. G. U. also includes the chairmen of the Divisions of Foreign Relations, Physical Sciences, Chemistry and Chemical Technology, Geology and Geography, and Biology and Agriculture.

I. Officers and personnel of the Union have interchanged information with foreign countries, other than for war purposes during the past two years, especially with Great Britain and Canada.

II. The last international meeting was to have been held in Norway. According to a letter from the Norwegian Embassy, Washington, D. C.: "The Ministry of Education and Ecclesiastical Affairs considers the invitation to be still in force and regards it as a great honor for Norway to be host for the next meeting of your Union, in which so many Norwegian Scientists have taken an active part." (Nov. 23, 1943.)

III. Informal interim reports are maintained through national committees. *See also* Central International Commission. The Union has maintained contacts with the other Unions, notably the I. A. U., and the I. C. S. U., during the war period. Triennial and other publications will be resumed after the war, and copies of the 1939 Transactions are reserved for distribution to all adhering nations at the earliest opportunity. The Union continues to receive dues, because of adherence, from the United States Government, and from the British Government. The bulk of the Union's funds are banked in Great Britain and in the United States. The Union, during the war, has financed several projects.

IV. *See* reports from the Associations and Commissions (pp. 272-277).

V. A large number of projects in which the Union coöperates and should continue to coöperate, with equal advantage to all countries.

VI. Post-war international coöperation in science and education could not be better served by other organizations than by international scientific unions. Of the 32 countries which adhere to this Union, 3 are 'Axis' enemies, 14 are in enemy hands, 4 are neutrals with whom no contact is allowed, 4 are British, and 7 are in the Americas. The particular value of a union, rather than a congress, is that a union provides: 1, Continuity of touch in administration and finance. 2, Power of instituting, at once, some much needed practical collaboration, with a minimum of institutional or national politics. (March, 1944.)

## a. International Association of Geodesy: —

I. Frequent contact has been maintained by correspondence between American officers of the International Association of Geodesy with accessible officers of that organization and of the International Union of Geodesy and Geophysics in other countries. The national society (or nearest corresponding organization) for Geodesy in the United States of America is the Section of Geodesy of the American Geophysical Union. There has been contact by correspondence between its officers and members and geodesists in other countries. Some of the work done by the U. S. Coast and Geodetic Survey is restricted or confidential during the war. No other information available. Considerable attention has been given to promoting an interest in geodesy and to the initiation of actual geodetic work in Latin America. Some of the Latin American countries have been nominal members of the International Union of Geodesy and Geophysics and therefore of the International Association of Geodesy but have taken almost no part in its affairs. It is hoped that after the war all Latin American countries will participate actively in the work of the International Association of Geodesy.

II. It is planned to hold a meeting of the International Union of Geodesy and Geophysics, and of its branch, the International Association of Geodesy, at Bergen, Norway, as soon as conditions will permit. The invitation for the Bergen meeting was given and accepted at the 1939 meeting in Washington, D. C.

III. War conditions prevented the publication of much of the material that would normally have been published in connection with the 1939 meeting of the International Association of Geodesy. The publication of two reports of the International Association of Geodesy, which would otherwise have gone unpublished, was undertaken by the U. S. Coast and Geodetic Survey. The American Geophysical Union sponsored

and financed the publication of a pamphlet containing the proceedings of the 1939 (Washington) meeting of the International Association of Geodesy. These proceedings would normally have been published in the *Bulletin geodésique,* official organ of the International Association of Geodesy, publication of which was interrupted by the war. The correspondence already referred to dealt in part with the resumption of publication of various sorts. The International Union of Geodesy and Geophysics of which the International Association of Geodesy is a branch, has continued to receive from the State Department money for the annual dues of the United States of America to the International Union of Geodesy and Geophysics.

IV. Contact particularly with the International Astronomical Union, especially in connection with the work of the International Latitude Service, which receives support both from the International Astronomical Union and the International Association of Geodesy (compare this statement with that of the I. A. U.).

V. In geodesy alone there are the International Latitude Service (Central Office at Naples), the Bureau international de l'Heure (Central Office in Paris) and the Isostatic Reduction Office (office in Helsinki). "The International Bibliography of Geodesy is issued triennially, but only two volumes have appeared and not enough copies are available. This Bibliography covers in principle all European languages and includes non-critical abstracts of the books and articles listed. This Bibliography of Geodesy is extremely useful and deserves international support, because the income received from subscribers and purchasers of copies will not suffice to maintain it." (W. D. LAMBERT, Sept. 7, 1944.) Some means should be found to assure the continuance of these offices.

The International Association of Geodesy also has triennial reports made by designated reporters on various branches of the subject. These should be of general interest to member countries, though not necessarily, of course, equally so to all of them.

VI. Something very like the Unions is needed in my opinion. Congresses do not ensure the necessary continuity nor provide for the support of continuing projects, such as are mentioned under V. Congresses do, however, make possible a wider participation by interested persons. There is always the possibility that the Unions, with their attendance limited to official delegates, may get into the hands of a self-perpetuating clique.

Perhaps the Unions might sponsor Congresses with fewer restrictions on the attendance of delegates, or provision might be made for larger and possibly more representative delegations to the ordinary Union meetings. These meetings, however, could easily become too large for the convenient transaction of necessary business, in which case such business would probably be railroaded through by a small cohesive group.

There seems to be no ideal solution. (Sept. 4, 1944.)

## b. International Association of Seismology: —

I. Considerable correspondence has been carried on with available officers of both the Association and the Union during the war. Appointment of a Vice-President to replace the deceased (French). Contact maintained with national societies and their international operations. Personal correspondence and informal conferences regarding post-war plans. "Dr. ROBERT STONELY of Cambridge University (England) has accepted appointment as acting vice-president of the Association to replace F. J. WHIPPLE (deceased). On the assumption that central France may soon be liberated I have informed acting Vice-President STONELY of my views as to what ought to be done about the Central Bureau of the International Association of Seismology." (N. H. HECK, President, Aug. 12, 1944.)

II. *See* j. V and VI (p. 276).

III. Interim reports have been made, particularly to the N. R. C. and to allied American organizations, including government agencies. Together with Commission on Continental and Oceanic Structure the Association has helped finance continuity of seismograph stations in Greenland and Bermuda.

IV. It has kept in touch with all available officers, or their alternates, of the other International Associations.

V. Seismology is essentially an international subject which requires complete interchange of instrumental records and the careful consideration of the best location of seismographs in all parts of the world.

VI. Since the Association survived the last war, and has shown considerable vitality during this one, its continuance is particularly warranted.

### c. International Association of Meteorology: —

I. No direct interchange of information has gone on during the war through officers of this Association except between England and the U. S. A. Science abstracts have been helpful. Also wireless abstracts and occasional scientific reprints are received from colleagues in Sweden and Switzerland. There has been no direct scientific contact with Russia.

II. Preparations should be started for an international meeting of the Executive Committees of the Union and their associations, with, possibly, addition of other scientists personally invited.

III. The Royal Society is considering the whole future of international organizations of science, with special committees considering future needs of the various branches of geophysics, including a review of governmental help, regarded as necessary.

IV. *See* I.

V. There are a number of international projects in which the Association should participate, to a much larger extent than before the war.

VI. Renewal and improvement of the Union and its associations are most important for the progress of science, especially astronomy and geophysics. Activities can be most usefully extended, but methods to be adopted will need careful consideration to avoid some of the jealousies (*see* pp. 285-287) and inefficiency in the pre-war unions.

### d. International Association of Magnetism and Electricity: —

I. Informal interim reports have been continued since 1929 through several committees and commissions. Continuance of magnetic character-figures has been maintained with the coöperation of the Carnegie Institution of Washington.

II. *See* I.

III. *See* I.

IV. Important fundamental problems, the solution of which requires the continuous international coöperation of geomagnetism, meteorology and volcanism, are being carefully considered.

V. A number of specific projects require the help of the other associations, because of essential international continuity of instrumental surveys and interchange of observations and record, such as: maintenance of magnetic character of days, reduction of magnetic observations of isomagnetic charts, etc. *See also* report of Commission on Continental and Oceanic Structure (p. 276).

VI. The Association, because of its contacts, experience and interests, is particularly prepared for coöperation with other international agencies in post-war science and education. This is particularly true in the case of oceanographic magnetic surveys, both for fundamental and practical reasons.

### e. International Association of Oceanography. — For sub-oceanic geomorphology and geology *see* report of Commission on Contintental and Oceanic Structure, I. U. G. G.

I. No comments.

II. The National Committee appreciates the economic and political aspects of scientific oceanography.

III. No comments.

IV. The National Committee is particularly interested in planning a vigorous program of research in the Pacific Ocean, and will need the coöperation of the Association.

f. **International Association of Vulcanology.** — No report has been received, but a statement by its Vice-President (U. S. A.), August 8, 1943, is as follows: "I do not believe in international organizations but in individuals . . . Vulcanological research should be entirely local and institutional." *See also* statement of the Commission on Continental and Oceanic Structure (p. 276). In contradistinction it is reported from London that "as no communication has been, or is, possible between the President of the Association, Professor MICHEL-LEVY, and the world outside the conflict, the Secretary-General, Brigadier WINTERBOTHAM, has appointed J. E. RICHEY as an Emergency President to act for Professor MICHEL-LEVY."

g. **International Association of Hydrology:** —

I. Since 1939 there has been limited correspondence among the officers of the Association.

II. The work of the Association has been done chiefly through the agency of several International Commissions, the principal ones being: Commissions on Potamology, Limnology, Subterranean Water, Snow and Glaciers. All of these commissions have European Presidents except the Commission on Snow and Glaciers and the Commission on Subterranean Water. *See* separate report by J. E. CHURCH, President, Commission on Snow and Glaciers and O. E. MEINZER, President, Commission on Subterranean Water (pp. 275, 276).

III. The Vice-President of the Association was present at the last meeting of the I. U. G. G. in Washington, 1939. The Secretary of the Association arrived but left immediately on account of the war. F. E. MATTHES served as temporary Chairman for the Washington meeting, but the Proceedings have not yet been published.

IV. *See* I and II.

V. *See* reports of Commissions on Subterranean Water and on Snow and Glaciers.

VI. "The next meeting of the International Association of Scientific Hydrology will, of course, be determined by the decisions that are made in regard to the next meeting of the International Union of Geodesy and Geophysics, of which it is a part. It seems to me that it is too early to make decisions in regard to such a meeting, but I am heartily in favor of holding a meeting as soon after the war as may be practicable. It would certainly be fine if the meeting could be held in Norway, as was voted at the Washington meeting (1939), but I appreciate that our plans will have to be adapted to the conditions that will exist at the close of the war." (O. E. MEINZER, Aug. 26, 1944.)

h. **International Commission on Snow and Glaciers:** —

I. There has been some correspondence, since 1939, with Russia, Switzerland, England, Australia, New Zealand.

II. The plan is to meet with the International Union of Geodesy and Geophysics at Oslo or Bergen, Norway, to catch up on the program for 1942, wrecked by the war.

III. As a result of the war, substitute officers were temporarily selected, for those in occupied countries, to carry on the business of the Association, in order to restart full international activity at the very first possible moment.

1. No interim reports.
2. Resumption of an international journal or transactions.
3. Reprints have been stored for distribution to all countries as soon as possible.

IV. There has been interchange of opinions, particularly during the war, with GERALD SELIGMAN, England, and OTTO LÜTSCHG, President of the Association, Switzerland.

V. Numerous projects require international coöperation for the benefit of all countries. We are, therefore, not waiting for the war to end in order "to reawaken scientifically to the melancholy waste of time in destroying what has been so laboriously built up." (J. E. CHURCH, Aug. 28, 1944.)

VI. *See* II. Also: "The Association of Scientific Hydrology deserves specific commendation because of the breadth of view and sturdy leadership of its past president, SMETNA, and President LÜTSCHG. Its executive Committee even on the eve of the outbreak of hostilities was represented in a meeting of the countries of Europe and showed a remarkable unanimity of policy and loyal support of President LÜTSCHG as against the ultra conservative attitude of our French Secretary, DIENERT." (J. E. CHURCH, Aug. 28, 1944.)

## i. International Commission on Subterranean Water: —

I. There has been correspondence with the President and Vice-President of the International Association of Scientific Hydrology; also with the President of the International Commission on Snow and Glaciers. There has also been some correspondence with members of the Commission, in different parts of the world, during the war. The principal activity of the Commission, during the war, has been in the Western Hemisphere with the members and advisory members from the Latin American countries. This activity has been aided by the coöperation of the U. S. Geological Survey, the Pan-American Union, and the Office of the Coordinator of Inter-American affairs. This has been accomplished in spite of the pressure of war work. (*See* Transactions of the American Geophysical Union for 1943 and 1944.)

II. *See* p. 275, g. II.

III. *See* I.

IV. Only through the central bureau of the International Association of Scientific Hydrology, *see* I.

V. Not mentioned specifically, but implied.

VI. Not mentioned specifically, but implied.

**j. International Commission on Continental and Oceanic Structure.**—This central organization was created by the International Union of Geodesy and Geophysics during the Seventh General Assembly at Edinburgh in 1936. Its primary function is to promote the use of geophysical methods in the solution of the structural problems of suboceanic and continental areas, with the essential coöperation of geologists and their national and international organizations.

I. There has been interchange of information with all available officers of the I. U. G. G., both in the U. S. A., and other countries during the war; also with such national societies as the American Institute of Mining Engineers, the American Association of Petroleum Geologists, the American Physics Society, the American Institute of Physics, the Geological Society of America, the Geological Society of London, and numerous educational and research institutions.

II. A report is planned for the next meeting of the International Union of Geodesy and Geophysics.

III. The Commission has contributed to several interim reports (1939-1944), including those of the Division of Foreign Relations, N. R. C. Its last interim report was published in April, 1943, and it has material already prepared for the resumption of the transactions of the I. U. G. G. The work of the Commission is still maintained by funds from the I. U. G. G.

IV. The Commission has maintained continuous communication with the American (U. S. A., Canada, and Mexico) officers of the I. U. G. G., also with the officers of the International Geological Congress, and the American representatives of related international organizations, *i.e.*, physics, engineering, chemistry, meteorology, geophysics, and, when necessary, with the U. S. Department of State, and the Washington Embassies of the Netherlands, Norway, and Finland.

V. International projects which have been sponsored by the Commission are: (*1*) Gravimetric and suboceanic topographic surveys of the Gulf Caribbean region and the English Channel, requiring the coöperation of the International Association of Geodesy, the British and American Navies, the United States Coast and Geodetic Sur-

vey, the American Bell Telephone Laboratories, the Royal Society of Great Britain, Cambridge University (England), Lehigh University (U. S. A.), Princeton University (U. S. A.), the U. S. National Research Council, the American Geophysical Union, and other private national institutions and agencies. (*2*) Initiated suboceanic seismic exploration of the Atlantic Ocean with the coöperation of the International Association of Terrestrial Magnetism and Electricity, the United States Geological Survey, the Geological Society of America, the Woods Hole Oceanographic Institute (U. S. A.), the U. S. National Research Council, the Guggenheim Foundation (U. S. A.), the Geological Society of London, the Royal Society of London, and other private national institutions and business corporations. (*3*) Coöperation with the International Association of Seismology in the maintenance of seismographic stations in Bermuda, Greenland, and Latin American Countries. (*4*) Coöperation in the tabulation and publication of international data of international significance.

VI. The Commission has particularly stressed the need for further coöperation of numerous agencies in the solution of fundamental problems in geoscience, both within and without the I. U. G. G. Examples: (*1*) Geographic coordinates in relation to problems in structural geology. (*2*) Plans for joint British-American survey of the Mid-Atlantic Ridge. (*3*) Continuation of geophysical-geological exploration of island arcs, as essential to better understanding of mountain building and geosynclines. (*4*) Study of earthquake velocities and isoporic foci with special reference to differences in the continental and suboceanic lithosphere. (*5*) The geophysical, as well as the geochemical, study of volcanoes as an indication of subcrustal conditions. (*6*) Configuration of the Pre-Cambrian basement. (*7*) Cosmic terrestrial relationships. (*8*) Contributions to the methods for improving international coöperation in science and its social implications.

VII. In spite of the war the Commission has been able to prepare for its post-war responsibilities by maintaining correspondence, and informal conferences, with the available officers of the Associations of the I. U. G. G., including its General Secretary. It has further maintained its interim efficiency by the appointment of alternates for 'Axis', and for 'Axis' occupied countries, until such time as the scientists of these countries are able to resume their proper responsibilities. As an active implement of the I. U. G. G., the Commission considers that all international scientific unions have exceptional opportunities for the increase of comity among nations through international coöperation in fundamental science.

## C. **The Primary Sciences** (as defined on p. 263.)

a. **International Union of Pure and Applied Physics.** — Physics is represented on the U. S. National Research Council by the Division of Physical Sciences. No report (*See* Part V, p. 290.)

1. *International Bureau of Weights and Measures.* The office of the Bureau is located in Paris. A recent letter from the Director made no mention of interference with his work other than that he found it necessary to make a great reduction in his staff owing to lack of funds. The U. S. Government and that of Great Britain has a definite policy not to transmit funds to agencies in occupied (and Russia occupied?) territory.

2. *International Commission on Illumination.* Represented on the U. S. National Research Council. It is reported inactive during the past year, but the National Committee of the I. C. I. met in November, 1933, and elected officers.

3. *International Electrotechnical Commissions.* Represented on the U. S. National Research Council. It is reported inactive during the past year, but the National Committee of the I. C. C. held its annual meeting and elected officers in December, 1943.

4. *International Scientific Radio Union.* Represented on the U. S. National Research Council. Reported no activity during the past four years.

b. **International Union of Chemistry.** — Chemistry is represented

on the U. S. National Research Council by the Division of Chemistry and Chemical Technology: —

I. The Union has maintained contact with the National Committees and Societies of Sweden, Switzerland, Russia, Spain, England, and Mexico, as well as with individuals and organizations in Peru, Chile, Argentina, China, and Australia.

II. At the last meeting of the Union (1938) it was planned to hold the next meeting in London in conjunction with a Congress of Applied Chemistry.

III. A valuable feature of the Union is the ability to help organize national committees in various fields, especially nomenclature and standards. Such committees of the Union are still at work. Examples: Committee on Atoms, Annual Tables of Physical Constants, Committee on Revision of Biological Chemistry, Committee on Carbohydrate Nomenclature, etc.

IV. *See* I.

V. *See* III.

VI. Not specifically answered, but implied.

c. **International Mathematics.** — Mathematics is not represented on the National Research Council by a Division, except as it is covered by the Division of Physical Sciences. The following report comes from the former Secretary of the International Mathematical Congress.

I. Individuals have kept up desultory correspondence with research mathematicians in all countries except Germany and some of the occupied countries (and in some cases clandestine correspondence with the exceptioned countries). Relations with Britain during the last two years in regard to war research have been intimate. "More than half of the leading 300 American mathematicians are engaged full-time in the mathematics underlying the mechanical engineering of war weapons. There are today more of the leading German mathematicians in the United States than there are in Germany." The method of correspondence with Russia has been to write to the Academy and request that the attention of certain people be called to the questions raised. This method has been successful, and is all the more important because "quite extraordinary mathematical developments are taking place in Russia and the feeling between Russian mathematicians and the American mathematicians, which has always been cordial, continues to be so."

II. The Congress which was to have been held in Cambridge, Mass. (Harvard University?), under the auspices of the American Mathematical Society in September, 1940, was postponed. It is expected that as soon as travel conditions warrant after cessation of hostilities this Congress will be held. "American mathematicians believe that they can contribute to the peace of the world by keeping up cordial relations with colleagues in all countries (including many who are anti-Nazi or non-political in Germany)."

III. Several libraries and individuals have been able to obtain practically all the mathematical material published in Europe. During the war period journals from Germany and Russia are somewhat belated in reaching the United States, but are obtained by some of the libraries which are making the contents available on microfilm to interested parties.

IV. *See* I.

V. In 1938, the Germans disrupted the staff of the *Zentralblatt für Mathematik und ihre Grenzgebiete.* The United States then started its own abstracting Journal, *Mathematical Reviews,* edited by OTTO NEUGEBAUER, formerly of the *Zentralblatt.*

VI. "For over fifty years the mathematicians have been holding International Congresses, generally at four-year intervals. It has been found that these congresses are better handled without the aid of the organization of an international union. Mathematics does not require such intimate international coöperation as projects in Astronomy." (R. G. D. RICHARDSON, Aug. 22, 1944.)

D. **VIIIth International Science Congress (1939).** — This is a type illustration of an international meeting instigated by one or more govern-

ments and including all phases of science, history, politics, economics, and education. The following report is as of 1944. W. KELCHNER, Chief, Division of International Conferences, U. S. Department of State, has been very helpful in advising on all matters relating to international conferences. He has not, however, expressed his opinion for this report as to the efficiency of the congress: —

a. *Section on Physical and Chemical Sciences.*

I. The Congress did not particularly further stimulate international correspondence in chemistry and physics.

II. No further meeting is planned.

III. There has been limited correspondence with government officials and other individuals in Mexico and in South America.

IV. *See* III.

V. Not answered; but it is noted that there are very few contributions on physics and chemistry from Latin America.

VI. Except for the United States and Canada, there is not enough Pan-American interest to warrant another meeting.

b. *Section on Geological Sciences.*

I. The only continuing activity is the promotion of a geological map of South America similar to the geological map of Canada and the United States.

II. The Geological Section was disbanded at close of the sessions.

III. *See* I.

IV. Not officially.

V. *See* I.

VI. Next Congress planned to meet in Cuba when conditions permit.

c. *Section on Public Health and Medicine.* No comment except that the Congress has not yet attained the status of a permanent body.

d. *Section on International Scientific Exchange.*

I. The Section has had no relations with organizations or individuals since 1940.

II. Not planning to meet again.

III. "Section not a congress, a society, a union, a council, or anything else deserving recognition by the Division of Foreign Relations, N. R. C."

IV. *See* I.

V. *See* I.

VI. *See* II.

e. *Section on Economics and Sociology.*

I. The Section has not functioned since the meeting of the Congress. There has been no personal correspondence except to obtain manuscripts for publication in the proceedings.

II. Not answered except by implication.

III. *See* I.

IV. *See* I.

V. *See* I.

VI. Not answered.

f. *Section on Agriculture and Conservation.*

I. Apparently the Section of Agriculture and Conservation of the Eighth American Scientific Congress has ceased functioning and, for all practical purposes, no longer exists. In the field of soil and water conservation, however, the Pan-American Soil Conservation Commission has been created in accordance with a Resolution passed at the meeting of the Eighth Scientific Congress, and this body has functioned as well as one might reasonably expect during the wartime period. There has been correspondence and some interchange of information between the officers and personnel of the Commission in the United States and foreign countries, and between the Commission and various appropriate scientific and educational societies.

II. The Commission is seriously considering an international meeting as soon as world conditions permit in order to provide for an orderly exchange of information and to help provide sound scientific guidance to the healthy interest in soil and water

conservation work which is developing with truly astonishing speed in many countries of the world, and particularly in the Americas. This matter may be further discussed by members of the Commission at a meeting of the Third Inter-American conference to be held at Caracas, Venezuela, July, 1945.

III. From available information, the Commission has not maintained or undertaken to date the activities listed in this category, although the Commission contemplates the preparation of interim reports, the preparation of an international journal, and the international interchange of technical bulletins and other information on soil and water conservation as soon as world conditions permit. Nothing definite, however, has as yet been determined with regard to these activities.

IV. A number of the Commission's officers have kept in touch, on an informal basis, with their colleagues in the other Unions, and particularly with the Pan-American Union.

V. The Pan-American Soil Conservation Commission could participate, with essentially equal advantage to all coöperating countries, in a variety of scientific projects in the field of soil and water conservation. There is already considerable enthusiasm in several countries (as expressed, also, at the United Nations Conference on Food and Agriculture) for the inauguration of such projects.

VI. While much good toward post-war international coöperation could be achieved through activities of international scientific congresses and unions I still think we also need a wide exchange of students who would carry out some actual work to show what nations can do to help one another. In the field of agriculture the Soil Conservation Mission to Venezuela after making recommendations with respect to a practical work program for that country went into the field and actually carried out on a variety of farms soil conservation operations as we perform them in the United States. This proved helpful and Venezuela is continuing the work that our mission got under way. Another instance is that of Dr. W. C. LOWDERMILK of this service who on his visit to China, 1943, carried out actual soil conservation work with a large number of Chinese technicians. I think this kind of practical coöperation would accomplish a great deal in the way of better international understanding in furtherance of accomplishments of international scientific congresses." H. H. BENNETT, Feb. 22, 1945. Mention should also be made of the International Society of Soil Science which operates continuously (since 1926) by means of six commissions and several subcommissions. (L. L. LEE, March, 1945.)

g. *Section on Biological Sciences.* No reply due to illness of Chairman.

h. *Section on History and Geography.*

I. There has been no interchange of information since the meeting of the Congress, but some personal correspondence with Latin Americans.

II. It is supposed that the Section will meet again, but the Congresses are planned by the State Department and the officers do not continue from year to year (between meetings?).

III. The Congress is not a continuing affair.

IV. *See* III.

V. Special international projects do not apply to a scientific Congress.

VI. *See* II.

i. *Section on International Law and Jurisprudence.* This Section was created only to function during the Congress (May 10-18, 1940), and the activities of the officers of the Section were entirely concerned with preparations for the meeting and with preparation and editing of the proceedings.

j. *Section on Anthropological Sciences.*

I. Duties of Section were limited to inviting Latin American and United States workers in these fields to attend the Congress and present papers, to the arrangement of a program and to some advice on the publication of results. The work of the Section terminated with the publication of Vol. II of the Proceedings in 1942.

II. It is hoped that there will be post-war international coöperation in science, education, and other cultural activities and that they will derive their powers from genuinely democratic institutions free of all political dictation.

III, IV, V, VI. Referred to General Secretary of the Congress.

k. *Section on Education.* With the completing of the Congress there has been no further official activity of this Section, or of its members.

l. *Congress as a Whole.*

I. "It is my (A. Wetmore, Sec. Gen. of the Congress) own feeling that these congresses serve a very definite function here in the New World in promoting closer relations among scientific workers."

II. The expenses of these congresses are met by the host country. Each of these congresses operates independently of its predecessors since the officers for each congress are selected by the country that is host for the meeting. The next meeting is to be held in Cuba at a time to be designated by the authorities of that country. The officers of the 9th Congress also will be selected by the Cuban authorities.

III. Under the conditions (*see II*) interim reports are not made except in the form of the Proceedings which it has been customary to publish as soon after the Congress as practicable. For this Congress the Proceedings are 12 volumes—one volume on the Congress as a whole, with an additional volume for each of the 11 Sections.

IV. *See* VI.

V. Resolutions were adopted which have led to continued activities that are still being promoted. Specifically mentioned: The development of an international statistical organization to promote this type of work and the formation of an Inter-American Institute to deal with tropical agriculture, work under which is now going actively forward.

VI. "The result of this last Congress has been most gratifying in its development of closer relations between scientific workers in a wide variety of fields in all the 21 American Republics." (Compare with previous statements of Chairmen of Sections.)

## E. International Scientific Organizations: —

"A problem of great importance that will shortly become one of extreme urgency has to do with the continuation and the resumption of activities of the numerous international scientific organizations that existed in 1939.

Such organizations have been created in almost all fields of science and scholarship. They include not only the international scientific unions, federated in the International Council of Scientific Unions, but also the International Union of Academies, the International Committee of Historical Sciences, the International Federation of Library Associations, the International Congress of Orientalists, the International Congress of Linguists, the International Congresses of Anthropology and Ethnology, etc. These organizations had developed into important agencies for promoting collaboration between the intellectuals of the different countries and for providing occasions for those intellectuals to meet at regular intervals.

After the end of hostilities, a situation analogous to that of 1919-1920 will exist, but it will be much more serious in degree. When the International Research Council was organized, German scientists were excluded from it and from the scientific unions for a period of years. When the International Union of Academies was organized in 1919 there was no exclusion of former enemy countries, but it was more than a decade before the German and Austrian academies became affiliated with the Union.

This situation gave rise to much uneasiness, and created difficulties with respect to the international congresses which are well remembered. Is it possible now to foresee the time when, and the circumstances under which, it will be possible to bring together German scholars and those of the other countries where a systematic effort has been made to destroy intellectual life into personal coöperation? Much will depend upon the degree of intellectual liberty which German scholars enjoy after the war, for the situation in the late '30's demonstrated convincingly how impossible it is for free scholars to work with those who are not free. Something also will depend upon the nature of the disciplines involved, for certain disciplines, such as anthropology, history, sociology, etc., are much more affected by emotional factors than are such disciplines as astronomy and geology.

It has been suggested that the practical course would be to resume as soon as possible activities of collaboration and publication that do not involve the actual meeting

of scholars and scientists, but that it will probably be inexpedient to attempt to hold international congresses until after a certain period has elapsed.

Another problem that American scientists and scholars must consider is what part the Government should be asked to take in the support of the international organizations. Up to the present time the Government has not supported them except to pay the dues of the United States in the international scientific unions, and to a minor extent through the purchase of publications. Now, however, that the Government has a working policy of cultural relations with other countries, and since the private funds from which most assistance to international activities has been drawn are greatly diminished, it is proper to inquire whether the Government should not assume a much larger part of the expense of American participation in international organizations. There are excellent arguments on both sides of this question, and I think it would be useful for the four national councils, as well as other interested national organizations, to give the matter immediate and careful attention." (W. G. LELAND, Report to Division of Foreign Relations, N. R. C., April, 1944.)

## F. Excerpts from the International Conference on Intellectual Coöperation in Havana, November, 1941: —

"Any international organization desirous to spread information regarding the needs for the safeguarding of peace or on the work of the League of Nations or on the merits of the democratic way, risks having little success with a country's Press, Radio or Film, for the simple reason that, in general, the Directors of the institutions in question wish to obtain on such matters the contributions of nationals, who, themselves, form their conclusions. In each nation there is prevalent a prejudice against foreigners tendering advice in matters of high concern to the nation and a disinclination to admit that political ideas, which originated outside the country, can be acted upon in the country just as they are ready made. Incidentally, a proof that such is the tendency is provided by the fact that in no country do the great media of public opinion reproduce to any extent the result obtained by the political or legal sciences of other nations or pay any great attention to their economists or publicists.

"The situation is different when it comes to the exact sciences the propositions of which are proved or refuted from observations or experiences according to established rules. Science has progressed enormously in our time. All the same, the results and methods which constitute the achievements of science do not reach the public to a sufficient extent nor in a satisfactory way today, in spite of a glamour of our Press, our Radio and our recording industry. As reproduced by these media scientific discoveries often are distorted or travestied. On that point the conditions do not improve; on the contrary they get worse. The masses, while knowing that science is great, do not get half the knowledge they wish or that might be useful to them. To attain this purpose, we must have a new class of scientists, a class that does not exist today — that is to say, of intermediary scientists who, interpreting discoveries in physics or chemistry, are to convert a meaning originally expressed in a highly symbolized mathematical language into a literary form with scientific exactness, thus enabling the real vulgarizers — journalists, radio commentators, film-script authors, etc., to present the matter to a general public with the maximum degree of exactness. What we need is, in other words, a link which belongs to science, itself, between the original scientists exploring the universe and those final distributors of scientific results and methods, who, in order to appeal to the public, must possess literary style and qualities of taste and a certain pedagogical ability. That a better knowledge of the results and methods of science (a knowledge the public does not possess today and never has possessed) is apt to help mankind, we somehow take for granted even if we deem, with ROUSSEAU, that science in itself does not serve social progress. In order to solve this problem, what is needed is coöperation between the different centres of sciences and, more particularly, the academies of science and the associations for the advancement of Science. Such a coöperation was on its way in 1939.

"*Assistance to already existing scientific organizations and enterprises and the starting of new ones.* The Organization for Intellectual Coöperation of the League of Nations was active only during recent years. Owing to its connection with Govern-

ments, the 'Organization' was able to give practical effect to ideas which up till then had been desiderata only (unifying of methods used in archeological excavations, introduction of the Latin alphabet to new countries, etc.). The 'Organization' was also helpful in organizing scientific conferences (in problems of physics, meteorology, etc.) and initiated some new enterprises (dictionaries and catalogues). The 'Organization' assumed the functions of a secretariat to some scientific unions and enterprises, especially in the field of the exact sciences. In this latter field the work of the 'Organization' developed fast as was natural because of the fact that science has become more and more a collectively organized activity which ignores national frontiers. Under the impact of the progressive specializing of the sciences, more and more international unions are created, and more and more international enterprises are started. In some cases, however, the union or the enterprise lacks the necessary means to enlist help; in other cases being a private organization, it has no such ready access to governments as might be desirable. In the field of the exact sciences, in 1937, the Council of Scientific Unions was formed, and for this council, the 'Organization' has acted as secretariat, without thereby endorsing the principal idea which underlay the formation of the Council, namely *that the men of the exact sciences should take a more active part in social politics.*" (A. Raestad, Nov. 1941.)

In May, 1942, A. Raestad received the following letter from A. V. Hill:

"I am very much obliged to you for your letter of 27 April and for your interesting report of the conference in which you participated last November. As you know, international coöperation in the scientific field is a matter which I have very closely at heart, and during the war itself I have been very concerned to see that proper scientific collaboration is established between the allies who are fighting together against a system which would mean the end of scientific freedom. To take an example only, the Royal Society of which I am secretary, saw an opportunity recently in the presence in London of a number of scientific representatives of the Dominions to collect them together to discuss coöperation, particularly with a view to the future, in scientific work. We have held a number of meetings and hope that in the end important results may be achieved. Later on, when we are clearer as to our plans, we hope to get America's representatives also to join us, and one of the things which we intend then to consider is the reestablishment of the international scientific unions which existed up to the time when the war began.

"In all such ways I believe that scientific people can help in the reestablishment of sensible friendly arrangements between different nations, and one may hope that those who are concerned with other studies, disciplines and branches of learning may find the same opportunities of collaboration as we in the natural sciences.

"The important thing in all this, I think, is to collaborate, *for by the actual process of collaboration we learn to understand each other and to find how it should be done. Solvitur ambulando.*

"All good wishes to you therefore, in your endeavours."

## G. International Directories: —

In reporting separately on the activities of the Botanical Section of the International Union of the Biological Sciences, Frans Verdoorn communicates as follows: "One of the most important and most pressing post-war duties of international organizations is to prepare new, up-to-date directories of research institutions and research workers. They are the basic tools in international relations work. In the case of such directories it is time to break with the old fashioned way of listing the scientist's activities in a vague, general way, *e.g., Plant physiology.* This is not too helpful from the point of view of international relations. It is much better to add a note about the work in which the colleague listed is currently engaged, *e.g., vernalization of cereals.*

## *Part IV*

# SUMMARY OF MAJORITY AND MINORITY OPINIONS

I. Participation of scientists and technological experts in organized international conferences may be classified as follows:

A. As expert advisers (consultants) to their respective governments, either as heads or delegates of government bureaux, or as individuals recommended or selected from the personnel of private organizations, such as universities and industrial corporations.

B. As members of bureaus or commissions organized by their respective governments, and largely, if not entirely, composed of government employees.

C. As representatives in congresses which are, or are not, preponderant in government personnel. It is peculiar to congresses that they have little or no continuity between meetings, which occur every three or four years.

D. As delegates of national academies, national societies and national research and educational institutions. Such international meetings are claimed to be less influenced by geopolitics, but they are the most sporadic, and depend entirely (to date) in most countries on private (philanthropic) financing. It is only in the case of classes A and B that the delegates are not expected to pay most, if not all, of their own expenses. It should be further noted that A and B illustrate the organization of scientists — partly, if not mainly — for economic and political (geopolitical) reasons, while C may be "border-line"; in this respect, D is primarily "international-academic". There appear to be certain practical differences between the Royal Society of Great Britain and the United States National Academy of Sciences. Sir HENRY T. TIZARD, Foreign Secretary of the Royal Society, states that the Royal Society has no scientific or political responsibility to the British Government, though the advice of the Society on scientific matters is often sought and on many occasions has been directly offered. The United States National Academy of Sciences was established precisely to bring to the aid of the Government the abilities and judgments of the leading men of science when that aid is asked. The National Research Council is an operating agency of the Academy, but, as such, was given the following directives by President WILSON in 1918:

"EXECUTIVE ORDER

The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the Council in organizing research and in securing coöperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is therefore requested to perpetuate the National Research Council, the duties of which shall be as follows:

*1.* In general, to stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

*2.* To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

*3.* To promote coöperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all coöperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

*4.* To serve as a means of bringing American and foreign investigators into active coöperation with the scientific and technical services to the War and Navy Departments and with those of the civil branches of the Government.

*5.* To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war, and to aid in the solution of these problems by organizing specific researches.

6. To gather and collate scientific and technical information, at home and abroad, in coöperation with governmental and other agencies, and to render such information available to duly accredited persons.

Effective prosecution of the Council's work requires the cordial collaboration of the scientific and technical branches of the Government, both military and civil. To this end representatives of the Government, upon the nomination of the National Academy of Sciences, will be designated by the President as members of the Council, as heretofore, and the heads of the departments immediately concerned will continue to coöperate in every way that may be required.

(Signed) WOODROW WILSON

*The White House*
*11 May, 1918* (No. 2859)"

The Russian Academy of Sciences is *directly* responsible to its Government. It should also be added that certain criticisms by American scientists of the lack of academic freedom of Russian scientists are incorrect, and largely founded upon the opinions expressed by some officers of some American scientific organizations. It is, perhaps, for this reason that recently the Russian Government, through its Academy, has preferred to communicate with individual American scientists rather than with their organizations.

E. As unions (international scientific unions). Here are combined many of the best (most constructive) features in A, B, C, and D, with important additional features such as: (*1*) Continuity of responsibilities, effort and finance, (*2*) a minimum of political and economic control by government agencies.

II. The following digest is primarily in terms of the opinions of scientists who have participated in one or more of the types of international conferences listed as A to E, and secondarily, according to their technical aptitudes. It should be noted, however, that with very few exceptions this is a digest of North American (United States, Canadian) and British Commonwealth opinions, *i.e.*, the opinions of the English-speaking scientists, and of their institutions. The reasons for the lack of available Latin American opinions are stated in Part III, D, pp. 278-283, together with the necessity for the opinions of other nations, notably the Netherlands, Switzerland, and the Finno-Scandinavian countries. Turkey and Russia exhibit a significant hiatus; and Germany, Italy, and France require immediate consideration in any post-war agenda and program on science and its social relations in Western Europe. The same is true for Japan and China in Asia.

III. *Digest.* The majority opinion of the available, responsible officers of international scientific organizations is that they are an essential implement to the progress and comity of nations. This is all the more significant because the roster includes scientists in the employ of both private and government organizations. But it should be noted that this majority opinion is largely due to geoscientists and to astronomers; an important exception are the geographers. In the case of mathematics it would appear that the leaders are somewhat asocial both in research and education, and have a tendency to national hibernation — in the scholarly sense — during periods of international conflict. This may be, in part, because research in fundamental mathematics is largely independent of travel and related observation even in times of world peace, when it is both helpful and pleasant to associate with — and honor — one's colleagues. There are some notable exceptions to this temporary analysis, but principally in the field of applied mathematics, as particularly exemplified by engineering, geophysics, and economics. Perhaps the mathematicians and astronomers best illustrate the aphorism of Dr. BRUZS of Latvia in his 1938 report to the Committee on Science and its Social Relations, of the International Council of Sci-

entific Unions: "I distinguish two elements in science, its utility and its intellectual charm."

Because chemistry and physics are fundamental techniques to all the other natural sciences they are, *par excellence,* examples of the interrelation of science and society through their economic application, particularly in medicine and in manufacture. It is therefore of some interest to note and compare the reports of American officers, and their adjutants, of the International organizations of chemistry and physics. According to the preceding introduction, the summary of the available data may be summarized as follows:

The majority opinion of the responding, responsible officers of the international scientific unions is:

1. *The scientific unions,* in view of their past experience, and accomplishments (1919-1944) are the most efficient existing international organizations both in promoting fundamental science, and in implementing the relation of science to human affairs. The principal defects in the past history of the unions which may be rectified by amendments to their charters are: (*a*) political jealousies arising from national pride, (*b*) over-emphasis of delegates of national institutions rather than of the science which the institutions represent, (*c*) national economic rivalry in the allocation of international funds and (*d*) indifference and consequent inefficiency of national committees. However, it has been demonstrated by those unions whose officers have accepted their responsibilities (1919-1944) that the self-criticisms listed have not seriously interfered with the fundamental directives or continuity of the unions; and, as well recognized, human phenomena are by no means peculiar to scientific organizations!

2. *International Congresses,* which have been primarily organized for national or geopolitical purposes, have been neither economical of the public funds, nor efficient in the expenditure of the scientists' time and energy. One reason why this has not been more fully appreciated by the public and their governmental representatives is not so much the technical difficulties of science as the fact that government scientists who participate in such congresses may not express their personal opinions on the efficiency of international meetings organized by their government. Furthermore, most non-government-employed scientists do not wish to discuss such matters as a scientific problem; those who do discuss them usually do so in relation to "academic freedom", "political control", "unscientific methods", and "emotionalism", which they attribute to either the legislative, or the executive (or both) branches of their government. This appears to be particularly the case in the United States, regardless of whether the critics are academicians or employed by commercial organizations. In the case of those Congresses which are primarily organized by the scientists themselves, the principal self-criticism seems to be lack of continuity in international coöperation between meetings. Many scientists, however, feel that this is a good thing because it prohibits the growth of purely political motives, while encouraging the further development of personal and group contacts as the desire for such coöperation develops naturally with the progress and consequent changes in scientific problems and techniques. Another difficulty is the lack of funds, except as raised by the national committee for the expenses of the congress in the country where it is held. This also is deemed an advantage by some scientists as it precludes any of the responsibilities connected with the administration of international funds.

3. *International Scientific Conferences Organized by National Private Organizations.* There is a strong preference among certain British and American scientists for this form of international coöperation, particularly in fundamental science. This preference, however, seems to be principally confined to college and university scientists, and especially those who have been elected to our most honored and most selective national academies and national societies. Other scientists, however, have noted that such international conferences are criticized by the public, and also tend to create political problems within the scientific body itself. Some of this criticism is probably

partly instigated through pique, but is certainly legitimate when it concerns science and society; also when it concerns inter-university and inter-academic rivalries rather than their coöperation. It seems, however, that there is a strong sentiment among some of the most able and most thoughtful scientists in the United States and the British Commonwealth favoring this method of international conferences, in spite of its lack of continuity and assured economy. The underlying implication, however, is the desire for conservative leadership and the complete avoidance of governmental control. For the reasons stated, it is particularly important that a careful, comparative analysis be made of the objectives and directives and organization of the Russian Academy of Sciences, The Royal Society of London, and the United States National Academy of Sciences. Probably no study by scientists of the impact of science on society could be more salutary for science and society. Such a study might serve to bridge certain troublesome difficulties which have arisen between the humanities and the sciences, particularly in the still largely theoretical fields of ideology and the "social sciences".

The answers to the questionnaire, plus additional correspondence, intimate, to date, that the most effective organized method of international coöperation in science is by means of the International Scientific Unions. This is, however, only a majority opinion — and also only a majority opinion of the available (Anglo-American) officers of the Unions.

To quote A. V. Hill, Secretary of The Royal Society of London: "The important thing in all this, I think, is to collaborate, for by the actual process of collaboration we learn to understand each other and to find out how it should be done. *Solvitur ambulando.*"

The international scientific unions have had more experience, both during war and peace, in all of the above mentioned problems in science and its social relations than any other type of international scientific organizations. The responsible officers of these unions are better aware, and consequently better prepared, to deal with these problems, and to improve their methods in dealing with them.

# *Part V*

# CONCLUSIONS AND RECOMMENDATIONS

"Only in their *natural settings* can we fully understand the languages, literatures, codes, ideas, interests and moralities of peoples unlike ourselves." ISAIAH BOWMAN, *New York Times*, Feb. 21, 1944.

"Molto bello, I agree with every word. Unfortunately, however, Italy has never been in a position where she could anticipate having access on equal terms to raw materials." MUSSOLINI to SUMNER WELLES, Feb. 25, 1940, quoted from *The Time for Decision*, Harper and Brothers, Publishers.

"It makes more than ever clear in my own mind the truth of what your President has said, that one of the essentials to a lasting peace is freedom and information." NEVILLE CHAMBERLAIN to SUMNER WELLES, March, 1940, *ibid.*

"Senators and Congressmen (legislators) are generally more responsive to opinions that come from voters in their own districts than to resolutions by a society with which they have no personal contact." Editorial. Mining and Metallurgical Society of America, *News Letter*, Nov. 15, 1943.

"There is an unfortunate tendency in easy times for the positions of responsibility to fall into the hands of men who are of the 'committee' or 'organization' type, for there are always available a number of men who like such assignments and perform adequately when not under pressure, but who may not have the energy and leadership to organize and direct a great program. This is particularly true when there is a tendency, quite naturally, to 'honor' a man because of his distinction rather than to select a man because he is the one on whom you would like to rely in a crisis like the present one." K. T. COMPTON to R. M. FIELD. Personal communication.

The "natural settings" within the national boundaries of any sovereign area include the discovery, exploration, and exploitation of all useful materials at, or near, the surface to a depth of one or more miles. The discovery, exploitation, and development of the useful materials depend primarily upon the scientific and technological ability of the inhabitants of the area. The scientific and technological ability of any nation depends, largely, upon its ability to exchange information with the technical experts of other nations. The useful materials are frequently referred to as "raw materials", or those materials without any, or all, of which a nation cannot manufacture the articles which it desires. All national and international trade in manufactured articles depends first of all upon access to "raw materials" and technology. Private enterprise has made great contributions to science and technology, but this is not recognized in the cost sheets of our national budget.

We have known for hundreds of years that the growth of science and technology has been most rapid in those countries which have had the most complete access to the required raw materials. The industrial progress of any nation depends, first of all, upon the interdependence of technology and

raw materials. With relatively recent acceleration in the growth of science and technology, industrial progress has required a greater quantity and variety of raw materials. Compare the amount and variety of raw materials needed by Great Britain when it had already created its Empire, with the amount and variety of raw materials which Great Britain now needs to even maintain a "Commonwealth of Nations." Compare Great Britain and Italy, from the same point of view, immediately after the signing of the Treaty of Versailles. This is an example of the relation of geoscience to geoeconomics and geopolitics. We continue to learn, through the acceleration in the growth of science and technology, that all nations are not equally favored in the quantity, quality, and variety of their raw materials; and that some nations have supplies of nearly all the raw materials they need, with surplus supplies of many commodities, while others are either deficient, or entirely lacking in certain of their requirements. According to boundaries, as of 1944, however, *no* single nation had assumed possession of, or access to, all of the raw materials vitally needed both in peace and war. Science, through synthesis (physical and organic chemistry and engineering, etc.) is learning how to help to alleviate some of the difficulties of this geoeconomic problem, but it cannot hope to solve the problem without also giving careful consideration to the excess raw materials within certain national areas. This knowledge is acquired through science and technology, and especially through the earth sciences, such as geology, geophysics, geochemistry, and biology.

The natural setting of any nation also includes the character and diversity of its topography, climate, and soils, with the consequent biology and ecology. It is this physical superficial variety in geography which must be still more fully understood in order to appreciate the origin of the more obvious differences in the "codes, ideas, interests, and moralities of people unlike ourselves." The basis of this knowledge also rests on science.

*The future rôle of science will be increasingly social in that science and human affairs have become inseparable. Popular science may no longer be defined only in terms of the marvels of inventions and new gadgets; popular science must also include the relation of science to society, and the sincere attempt by scientists, to see that this information is available not only to a few favored individuals or groups, but to all elements of society through whose coöperative efforts their developed environments have been created.*

The proper relation of science to government has been seriously neglected by our scientific leaders, and their organizations. Although readily available, there is little or no "freedom of information" even in the democracies, between our legislative and scientific organizations. This impractical situation is illustrated by many instances of well-meaning, but unnecessarily confusing and debatable legislative acts and proposals in the United States, such as Senate Bill S. 702, and its relation to the directives and responsibilities of the United States National Research Council and its parent organization, the National Academy of Sciences. Surely we need better liaison between science, public opinion and government than now exists through the separate deliberations of national scientific societies or academies, and of "Senators and Congressmen (who) are generally more responsive

to opinions that come from voters in their own districts". It is in the fields of medicine and engineering that scientists and technologists appear to have gained the most experience in improving the liaison between science and society, through economic necessity. It is suggested that this same necessity also exists in the whole complex area of science and international affairs, and that scientists have not yet thoroughly and scientifically considered this necessity as an ever increasing responsibility in the complete rôle of their activities. During the past two years we have had an excellent demonstration of the necessity of science in the art of geowar, and the remarkable recognition by scientists of this necessity. Will scientists equally recognize the necessity of their even greater responsibilities in helping to prepare for the period of reconstruction? The time is now, and it is still possible in the democracies for scientific men to select, for this purpose, those leaders whom they particularly trust in "an emergency".

**Conclusions:** — According to this Memorandum the international scientific organizations which seem to have operated most continuously and effectively from 1919 to 1944 are the International Unions of Astronomy, Chemistry, Geodesy and Geophysics, and Biology. The International Union of Pure and Applied Physics appears to have been the least active, and the least valued by its officers and members, either for the promotion of fundamental or applied physics. Due to the lack of expressed opinion (to date) on this matter by either the British or American officers of the Union, it is necessary to note the information provided by the Director of the recently formed American Institute of Physics, and by the President of the Massachusetts Institute of Technology.

"I have not, myself, been familiar with the activities of the International Union of Pure and Applied Physics . . . Until the Nazis began to close the laboratories of Germany it was the rule all over the world that physicists traveled freely. They could always enter a physics laboratory anywhere. They would be cordially received and shown all the researches in progress. The personal acquaintances across boundaries have always been close and numerous. I want to emphasize this because it has practically been very close to an ideal international coöperative arrangement and has been far more effective than any formal organization of unions or associations that has ever existed in science." (H. A. Barton, Aug. 21, 1944.)

"In so far as I can evaluate the matter, there has been no international organization of physicists which has been effective or significant. . . . Whether or not physicists have lost good opportunities through failure to develop a stronger interest in formal international organization is rather hard to evaluate. I have seen much of stimulus and value in a few of the international organizations in other fields such as the International Congress of Applied Mechanics. . . . I am inclined to think that the physicists generally look upon their scientific societies of physics as distinctly 'professional' and they prefer to let their participation in such more inclusive bodies as the Academy and Association of the American Institute of Physics be an expression of their active interest in such border questions as 'The Importance of Physics on Society' and so forth. . . . Finally I would say that I think an international union of physics could be successful if an enthusiastic group of young physicists in different countries were to approach the problem with necessary zeal. Otherwise, I do not think such a union would be successful or worth much time and effort." (K. T. Compton, Aug. 21, 1944.)

With the possible exception of the chemists, the primary scientists (as defined C, p. 263) suggests that they can accomplish more in the promotion of their technical interests without the organization of an international union.

It is further implied that they prefer to consider the impact of their technology on society within their national societies, and national academies. It would seem, therefore, that these national societies, national institutes, and national academies have a special responsibility in the problems of science and its social relations, particularly in relation to mathematics and physics.

One of the most active international scientific unions — with also particularly active national committees—is that of Geodesy and Geophysics. It is in this field of the application of physics to the study of the composition and structure of the earth that physicists seem to be more familiar with, and more interested in, the borderlines of science and human relations. The geophysicists also seem to be impelled by the same urge for continuous organized international coöperation as the astronomers, because of their mutual need of continuous, world-wide, field-observation as well as the interchange of the latest laboratory techniques and apparatus.

Geographers seem to be less definitive in their statements on international organizations. Further data are needed, but the American geographers, at present, do not seem to feel the need of either the present international union, or even an international congress. The geologists have no union, but have held successful congresses — the last in Russia. At present some of the leading American geologists are concerned with the organization of an American Geological Institute, patterned particularly on the American Institute of Physics and supported by national, founder, geological and geophysical organizations, but without international contacts.

In the United States it appears that the physicists, geologists, and geographers (both fundamental and applied) are favoring separate, technical national organizations in the approach to international problems. The recent statement (*Scientific Monthly,* August, 1944, p. 95) by Isaiah Bowman, President of Johns Hopkins University, and one of America's most eminent geographers, is pertinent to the international aspects of the close relation of history, science, and the humanities in research and in education. "We should make a Ph.D. mean something more than proficiency in a small sector of a great subject. A man should be capable of thinking about the meaning and the applications of his science, and not merely about a job in teaching 'courses' or advancement in salary in an industry by knowing enough to hold his job."

It would seem that the fields of anthropology and archeology have not been sufficiently explored from the international point of view, especially by the International Council of Scientific Unions and its Committee on Science and its Social Relations. Any nation may be proud of its archeology without interfering with the same pride in any other nation. Anthropology may be a somewhat delicate matter from the purely racial and national point of view; however, the natural self-interest of a group of people in themselves is best promoted by their personal participation in the required coöperative research. . . . "in our recent study of the Navajo Indian Problem I doubted if anywhere else in the world we could find a parallel to the extent of scientific research conducted as a basis for the reconstruction and human betterment program." (C. T. Loram to R. G. Harrison, 1940.) The success of this method is especially well illustrated by H. S. Colton and his staff, of the Museum of Arizona at Flagstaff.

In Western Europe in the Mediterranean area, in the Far East, and in Mexico, archeologists have already demonstrated both the right and wrong methods in international scientific coöperative research. The same is true in South America. Because of recent developments of essential techniques, from such diverse subjects as aerial photography to stratigraphy, the opportunities for interscientific and international coöperative research, from the geoscientific point of view, offer great possibilities.

Of all the natural sciences, probably biology — particularly botany — has the most promising future opportunity for promoting the welfare and comity of nations. "The natural sciences are a particularly fruitful field for international collaboration because they are themselves international; basic physical and biological laws are the same everywhere and are universally accepted. There is already a good deal of collaboration but much more could be done. Joint planning and exchange of information, services, materials, and personnel could and should be carried out in such a way that nations would be encouraged and assisted in enlarging agricultural research, applicable to their problems, while costly duplication could be reduced . . . ." (From: Final Act and Section Reports, United Nations Conference on Food and Agriculture, Hot Springs, Va., May 18-June 3, 1943, p. 54.)

Of particular significance is the growing appreciation by horticulturists of the intimate relation of plants to both the physical and cultural needs of all nations and races. Closely related to victory gardens, garden clubs, and landscape architecture, is the increasing popular interest and appreciation of the preservation of wild life in such sanctuaries as national reservations and national parks. Probably in no border-line of natural science is the amateur taking a greater and healthier interest in the relation of technology, economics, and politics to human affairs than in horticulture.

The problem of languages and international inter-communication has been as much, or more, discussed by scientists than by humanitarians. Only the mathematicians and the chemists have developed a fully accepted symbolism or "shorthand" which is truly international. The biologists and paleontologists of all countries continue to use Latin and Greek as basis for their classifications of animals and plants. These forms of international language, however, are effective only among scientists themselves and hinder rather than promote popular science both nationally and internationally. *No characteristic of a race, or of a nation, is so thoroughly a human characteristic as language.* Too great insistence at international meetings by the French that theirs be the "Court Language" has aroused serious international jealousies. Also because of their wide colonization and consequent technical and economic advantages, the English speaking scientists have expected "foreign" scientists to speak English. This disadvantage to the art of international inter-communications has been enhanced by the educational policies of both American and British Universities — particularly in their graduate schools — with the consequent decrease of the natural collaboration of the sciences and the humanities. The recent experiments in Esperanto and Basic English, or any other international language, illustrate mechanical methods for dealing with a fundamentally non-mechanical problem. The recent experiments by the Army and Navy schools, in teaching our soldiers and sailors the rudiments of such languages as Japanese, Chi-

nese, and Polynesian dialects, should be carefully considered by American schools and colleges.

The resumption of international scientific coöperation in fundamental science, as well as in science and its social relations, depends primarily upon the reservoir of scientific personnel in the about-to-be liberated countries, especially the smaller countries whose scientists have contributed so much to the progress of science and philosophy. American and British organizations — both universities and industrial corporations — have rendered a great service to the salvage of European scientists during the war. How many of these expatriate scientists will be ready and willing to return to their own countries and take active part in their reconstruction? In the United States there is already some evidence that these expatriates are planning not to return to their native lands. Entirely aside from the temporary technical advantage to this country, the concentration of the best European technical brains in North America and Britain will still further impoverish those already ravaged civilizations whose reconstruction depends fully as much on technical as on political leadership.

Finally, there is a serious need for an international scientific periodical devoted to the subject of science and its social relations. The English scientific periodical, *Nature,* and the official publications of the American Association for the Advancement of Science, *Science* and *The Scientific Monthly,* have recently helped to restore the philosophical and humanitarian aspects of science, so seriously neglected by educational institutions during the past fifty or more years.

**Recommendations:** — It has been definitely stated by the Allied Governments that post-war planning must be carried on during the winning of the war. The British, Russian, American, and Chinese Governments are already engaged in attempts at solving political, economic, and educational problems of the post-war period. On the assumption that science and technology are fundamental techniques in international relations, and that fundamental science affords an excellent opportunity for the improvement of methods in the art of international collaboration, the following suggestions are submitted as part of this Memorandum:

1. The Foreign Secretaries of the Russian Academy of Science, The Royal Society of Great Britain, and the National Academy of Sciences of the United States should explore the possibilities of an inter-Academy study of their international relations in those phases of science which are of benefit to all men and inimical to none.
2. The International Council of Scientific Unions, through its British and American officers, should simultaneously prepare a memorandum for all governments which have adhered to the International Scientific Unions, on how the Unions may best collaborate in post-war research and educational problems.
3. The Division of Foreign Relations of the United States National Research Council should continue to advise the United States Academy of Sciences in all international scientific matters which may, or may not, be in the self-interest of United States scientists, their institutions, and their related responsibilities, to the welfare of their countrymen.

Walter B. Cannon
*Chairman, Division of Foreign Relations, N.R.C.; Foreign Secretary, National Academy of Sciences*

Richard M. Field
*American Representative, Committee on Science and its Social Relations, I. C. S. U.; Member, Division of Foreign Relations, N. R. C.*

*Appendix 1*

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H. A. BARTON (physics)
C. H. BEHRE (economic geology)
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M. T. BOGERT (chemistry)*
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* Names marked with an asterisk are executive officers, or adjutants, of an international scientific organization.

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F. B. Hanson (education)
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H. Shapley (education and astronomy)
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A. Wetmore (international conferences)*
P. C. Whitney (international conferences)
C. L. Willard (international conferences)
Wendell Willkie, deceased Oct. 8, 1944 (interational relations)
H. St. J. L. Winterbotham (geophysics)*
J. K. Wright (geography)*

*Appendix 2*

## JOSEPH NEEDHAM'S "THE PLACE OF SCIENCE AND INTERNATIONAL SCIENTIFIC COÖPERATION IN POST-WAR WORLD COÖPERATION

On April 28, 1945, Dr. Joseph Needham issued, from Chungking, the final, third edition of his memorandum on "The Place of Science and International Scientific Coöperation in Post-War World Organization". Needham's memorandum, because it argues for the inclusion of science in the United Nations Organization (U.N.O.) should be compared and contrasted with the mimeographed bulletin "The Proposed Educational and Cultural Organizations of the United Nations", recently issued by the Division of Public Liaison, (U.S.) Department of State (September 1, 1945), with the attached statement that: "This material will be available shortly in pamphlet form, upon request addressed to this Division". Needham is to be congratulated on the care, time and thought which he has devoted to the compilation of his memoranda. Whether or not we agree with his latest conclusions or advice we should be grateful to him for the most complete summary of the problem which has, to date, been made available by any scientist or scientific organization of the British Commonwealth. Its chief value — we feel — is due to the facts: 1) it is full of personal contacts with many responsible workers in the U.S.A. and abroad, 2) his observations are carefully contrasted, without personal and institutional prejudice and with considerable insight as to the divergence of opinions of those in authority both in the United States and in the British Commonwealth. On September 12, 1945, the senior author of this booklet summarized his opinion as follows: "Needham's memorandum III certainly presents an elaborate—indeed, a grandiose plan. It would require immense sums to put it into operation . . . I also explained again [to the Foreign Secretary of the Royal Society] why we based our hopes of international coöperation in science on existing international unions". It is significant that Needham has dropped all refer-

ence to the directives and responsibilities of the International Council of Scientific Unions (I.C.S.U.) in his Memorandum III. He argues for the necessity of an International Science Coöperative Service (I.S.C.S.), and the importance of changing the name and organization of the United Nations Education and Cultural Organization (U.N.E.C.O.) so that it shall become the U.N.E.S.(Science)C.O. On September 11, 1945, V. CONNELL, Esq., of the United Kingdom Scientific Mission in the U.S.A., wrote us as follows: "Dr. NEEDHAM's memorandum is not an official statement but expresses his views. The question of science and post-war planning is receiving a good deal of attention in official circles in Great Britain at the present time and Dr. NEEDHAM's memorandum will naturally be considered in this connection."

The following quotations from NEEDHAM's memorandum III will not fail to be of interest to all who participate in any national or international conferences in the rôle of science in post-war world organizations: "The present writer's experience during the past two years in China in organizing and directing scientific and technical coöperation between China and the United Kingdom has led him to devote much thought to post-war international scientific coöperation. In two memoranda, the first written in Chungking, July, 1944; the second in London, December, 1944, he worked out a plan for an International Science Coöperative Service (I.S.C.S.) which should take its place beside the other international organizations stemming from whatever supreme world council of nations should take form at the conclusion of the war. The original idea, contained in correspondence with Dr. T. V. SUNG in December, 1943, thus came to take its place within the framework of Dumbarton Oaks . . . The international scientific unions were thus limited as to subject-matter; the bilateral science coöperative offices are limited as to national scope . . . In the future, there are two other types of international scientific intercourse which may grow up. One is the further extension into the scientific field of the bilateral cultural goodwill organizations (such as the British Council, Cultural Division of the U.S. Department of State, etc.). The other is the appointment of scientific attachés in the principal embassies. While there is much to be said for both these methods, the present writer now feels that since it is impossible to rid either of them of a fundamentally national emphasis, and an inevitable national loyalty on the part of the officials concerned, these methods are not fitted to play the major rôle, though they may well play a valuable minor rôle, in the international exchange of so basically international an activity as science . . . The writer has now had the opportunity of a large number of personal conversations with leading scientific men and government officials concerned with science in China, India, the United Kingdom, the United States, Canada and Australia . . . The dependence of all modern world civilization on applied science must find its expression in the sphere of international relations. This desire is more strongly expressed, however, the further one goes away from the United States; and in the United Kingdom it is much more noticeable among scientists under fifty than among those above that age. Some of the older generation, though theoretically in favor of international scientific coöperation, are distrustful of any machinery for doing it . . . The fundamental error of believers in what we may call "laissez-faire", however, is that they look at the scene too exclusively from the European-American point of view, that is to say, they think of oscillating between Paris, Brussels, London, New York, Washington, Montreal, and the like. They do not realise that the picture of world science looks very different when seen from Roumania, Peru, Java, Siam or China . . . The parochial theory of the "laissez-faire" school is that in science everyone knows everyone else, and can therefore easily get in touch when any problem arises which calls for it. But this is simply not the case in the greater part of the world . . . It would obviously be absurd for any international funds to be spent in communicating between people in the United Kingdom and the United States, for example, who are quite well able to communicate with each other . . . The I.S.C.S. should be directed, and indeed limited, to doing those things in international scientific coöperation which are not being done, by any other channels Acceptance of this principle would at once reassure those scientists within the "bright zone" who fear that some bureaucratic organization might come between them and the colleagues with whom they are familiar across the Atlantic . . . An eminent astronomer said to the writer "one assumes that a man has the necessary books and equipment, and then it lies between him and his maker." . . . The spontaneously arising scientific organizations before the war made the great mistake of thinking that

the battle was won when the organization was once written down on paper, and eminent scientists in different countries had accepted high positions in it. There thus grew up what might be called "invisible secretariats", existing on paper, and capable of doing no real work . . . In war-time, no facilities are too expensive for the scientist, no counsels are too high for him to take part in; he is implored, like ARCHIMEDES, to think up something for the nation's salvation. Then, when the tension is relaxed, political and private men alike sink back into the *otium* of an outworn "humanism", oblivious of the rest of human suffering throughout the world which needs the scientist's help just as much as the military survival of democratic nations . . . Since it is impossible to separate natural science either from applied science and technology on the one side, or from the humanistic sciences and philosophy on the other, it would probably be better to maintain the principle that U.N.E.C.O. should be U.N.E.S.C.O. and then to divide the work of an I.S.C.S between the more detailed matters suitable for the higher conciliar level . . . But of the value of having Science (Scientists) able to make its (their) contribution at the higher conciliar level there can be no doubt."

# LUTHER BURBANK

# CONTENTS

*The vignette on the title page shows the sandy, rolling land of Luther Burbank's experimental farm where all his fruits were tested before offering them for sale. The countryside here is lovely.*

# PROLOGUE

*The character sketches which make up this book have been prepared in a spirit of fair play to enable the reader to understand and appreciate* LUTHER BURBANK. *Circumstances over which he had little control clothed him in glittering tinsel, but a veil of darker hue was superposed when he became the tool of schemers. Temperament, eccentricities, and unwise talk — all nonessentials and unimportant — added to the confusion and helped to warp the judgment of observers. This was particularly true of those who had to reach conclusions at second hand.*

*With none too gentle hands I have endeavored to tear away these hindering habiliments to see what the real* BURBANK *looked like. And behold, a pristine figure emerges that is every inch a man of worth, a man of original ideas; a man with a definite mission in life, fully capable of standing on his own feet as a lone worker in the field of science.*

*It is impossible to evaluate* BURBANK'S *accomplishments with finality, but they were many and diverse, some direct, some indirect. Delving into details, the historian is amazed at the multiplicity of things that one man could do. With prejudice excluded, there still will be honest differences of opinion regarding the scientific value of his work. Liberals will concede much, the punctilious may equivocate.*

*I have to thank the following libraries for the loan of rare* BURBANK *publications — his catalogs and price lists: United States Department of Agriculture, Washington, D. C.; the Massachusetts Horticultural Society, Boston; the New York State Agricultural Experiment Station, Geneva; the New York State College, Department of Pomology, Ithaca; and the Missouri Botanical Garden, St. Louis. Professor* W. L. JEPSON *of Berkeley, California, contributed duplicates from his personal library. Other memorabilia — letters, pamphlets, clippings, photographs — were loaned or contributed by* H. E. V. PICKSTONE AND BROTHER, *Simondium, Cape of Good Hope, South Africa (complete file of correspondence with* BURBANK *for 29 years)*; VILMORIN-ANDRIEUX ET CIE., *Paris, France; the firm of* METTE, *Quedlinburg (oldest of German seedsmen, still handle* BURBANK *products), and* ERNST BENARY *of Erfurt, Germany;* J. J. H. GREGORY AND SON, *Marblehead, Massachusetts, and* MILLARD SHARPE *of Vacaville, California. Mrs.* BURBANK *kindly permitted me to examine in detail the 17-volume scrap book kept by* BURBANK *for fifty years, for which I am grateful. Finally, I am greatly indebted to the following persons for personal and professional information about* BURBANK: *Dr.* D. P. ANDERSON, *Mr.* FRANK DOYLE *and Miss* PAULINE OLSON *of Santa Rosa, California; Prof.* J. E. CHENOWETH *of Bakersfield, Mr.* WILL HENDERSON *of Fresno, and Mr.* W. I. BEESON *of Sebastopol, California; and especially to Dr.* GEORGE H. SHULL *of Princeton, New Jersey. I regret that it is not feasible to mention the scores of others from California and elsewhere who contributed bits of information. The old Scottish Lowland proverb was right, "many littles [do indeed] make a much".*

# I

## INTRODUCTION

ABOUT seventy years ago an ambitious young devotee of the gentle art of horticulture was beginning a career that was to lift him to heights of fame undreamed of in his most sanguine moments. During this career he was destined to taste the heady sweets of popular acclaim, as well as the ashes of disillusion. His critics were relentless, but to a host of admirers he was a benefactor, a knight in shining armor. This man was LUTHER BURBANK, erstwhile gardener from Massachusetts, who chose the new land of California as the locale for making his fortune, not in the mines but in the strange vocation of plant breeding. Had he given a name to his calling, which he did not, he doubtless would have termed it plant improvement or plant betterment.

As a dealer in plants — a nurseryman if you please — he was unorthodox, did unusual things: experimented with plants, built up a profitable business, and attained a nation-wide reputation, all without the expenditure of a dollar for publicity purposes. He claimed to be a humanitarian, engaged in the promotion of human welfare, not interested in money. Whether he was a success in advancing the art and science of his craft, as loudly proclaimed by his supporters, or contributed valuable plants to the world were subjects of endless and often bitter controversy. He was both praised and condemned, even accused of hoodwinking a credulous public.

Proponents and opponents had their say but no one attempted to study his career objectively. Mostly, one simply believed in BURBANK or did not. To argue was to be branded as a partisan. The situation was further complicated when exploiters brought his name into their schemes; his religious views were the subject of vitriolic debate. A national Foundation made a try at garnering the scientific results of his work but did not make known its findings. So nothing was settled.

My interest in BURBANK began in 1932 when I undertook to compile a list of his plant productions — that is, new varieties — which he had at one time or another offered for sale. The task grew and grew, until it developed into a full-fledged study of his life. Instead of being concluded in a few weeks or months, the research extended over a period of ten years. New material was encountered concerning the man himself, things that people had asked me about, and which had intrigued my own curiosity. I found the explanation to so many things not before understood that I am impelled to pass the knowledge along to others who, no doubt, will appreciate factual information about BURBANK.

Sources of my information were BURBANK's writings and what others had to say about him over a period of forty years. Added to this I had the testimony of dozens of persons who knew BURBANK, who had served him in one capacity or another, had had business dealings with him, or merely were spectators on the sidelines. These last often were only casual acquaintances of BURBANK — met him in church, lodge meetings, or greeted him on the street — but they knew much about his business and household affairs, for it must be remembered that Santa Rosa, forty years ago, was but a small country town. Helpful interpreters of things that had appeared in print, they were able to restore the original flavor to incidents which had dimmed through lapse of time.

Having accumulated too much indispensable material for a single volume, I lopped off the technical part, which has been lately published by the University of California Agricultural Experiment Station, as a public document, with the title: *Luther Burbank's Plant Contributions.* This will be of interest to gardeners and plant lovers. A summary occurs here — in Chapter XIX.

In relating my human interest story of BURBANK no attempt has been made to write a conventional biography. That has been done several times already, and in one instance — *Harvest of the Years* by HALL — very successfully. My aim has been to explain and clarify some of the principal episodes of his life. To this end, a number of seemingly unrelated topics or episodes were selected for discussion. These encompass the main events of his life, most of them controversial. Some may appear like opéra bouffe, yet they were seriously — and furiously — debated at the time. For purposes of driving home important points, repetition seemed unavoidable. More than one episode might be employed to emphasize the same point; for example, the subject's egotism.

I have been disturbed by the attitude of some of my valued correspondents. They assumed that my object in writing this story was to debunk BURBANK. This was not my purpose at all, any more than it was to debunk his critics; but if telling what appears to be the truth tends to bring him down to earth at times, all I can say is that other characters in the story will be exposed to the same hazard.

Despite all that has been written about BURBANK, the average citizen still yearns for the truth. Friend and foe alike have expressed this thought. The inference is clear. This lays a heavy responsibility upon the reporter who would record with fidelity the major occurrences in the life of a stormy petrel like LUTHER BURBANK. For who is wise enough to discern the truth under all circumstances? Certainly it is not always a simple question of veracity. In the BURBANK case, with its maze of conflicting versions of this or that incident, conclusions had to be arrived at through judgment and interpretation of motives. Even ethics had to be taken into account.

Custom has its weight and plays its part. Truth appears to be elastic: in moments of enthusiasm we are sometimes said to

stretch the truth. Of course, this is an euphemistic way of saying that we are exceeding the truth. Exaggeration, although a perversion of the truth, is widely tolerated. We employ exaggeration in our social conversation. We have our daily portion of it in the newspapers. We read it in the advertisements, and the ether waves quiver with it. Deplore it, yes, but accept it we must.

Logically, truth should be factual; but facts as applied to a situation or occurrence that took place thirty to forty years ago are as elusive as fleas. They are not only hard to capture but are difficult to evaluate. Fiction creeps in. To change the metaphor, tares become mixed with the grain, and there is the chaff to contend with. In the course of this inquiry there has been much sifting and winnowing and fumigating.

An effort has been made to take into consideration and make proper allowance for individual viewpoint, personal prejudice, envy and professional jealousy; for all these conditions have been encountered in the course of the BURBANK studies. A colorful character like BURBANK stirred many people, aroused diverse emotions. They reacted according to their viewpoint and training. First, there were the men of science in our schools and research institutions. Broadly, these may be divided into two groups: the older, general scientists, and the younger specialists who have grown up since 1900. The first, in the main, are tolerant, kindly disposed toward BURBANK and concede that he really accomplished much both directly and indirectly. The younger men are apt to judge him by the criterions they apply to themselves, their colleagues and contemporaries, and, consequently, reach the conclusion that he did not measure up as a scientist because he did not use the tools and standards which they employ: in short, that he does not rate at all, and is not worth considering. This group includes most of the geneticists now in active life.

Then there are the thousands of teachers in our American grade schools who have the training of our children during their most impressionable years. These have always idealized BURBANK and have often portrayed him as a sort of superman. I have contacted hundreds of these teachers all over the United States, and almost without exception they give him credit for possessing all the virtues and not a single fault. Many have supplied me, in great detail, with the kind of information they are giving. Their information is based on what they have read about BURBANK in the newspapers, magazines, Sunday supplements, and especially HARWOOD's magazine articles[1] and book[2]. Many of BURBANK's best friends have told me that it was unfortunate the book ever

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[1] HARWOOD, W. S., A maker of new plants and fruits. Scribner's Magazine, New York, July, 1904. — A wonder worker of science. Century Magazine, New York, 69: 656, 672, 821, 837. 1905. — LUTHER BURBANK's achievements. Country Calendar, Harrisburg, Pa., 1, 3: 244, July, 1905. — How LUTHER BURBANK creates new flowers. Ladies Home Journal, Philadelphia, Pa., May, 1907.

[2] HARWOOD, W. S., New creations in plant life; an authoritative account of the life and work of LUTHER BURBANK. 2nd ed. The Macmillan Company, New York, 1907.

was published. Under the treatment of this author, everything that BURBANK had done was played up as a marvel of accomplishment, often bordering on the supernatural. A discriminating reader, it is true, could pick out the grains of truth, smile at the exaggerations. The sentimental and the uninformed, however, are apt to accept the intemperate statements as facts, as the author doubtless intended they should do. If the book had come under the provisions of the National Pure Food Law it would have been necessary to entitle it "New Creations in Plant Life — A Fairy Story". HARWOOD delighted in making astonishing statements: "BURBANK has disproved MENDEL's work on peas, and also disproved DE VRIES' theory of mutants. . . . Here, as in hundreds of cases all through his career, the 'laws' have been shown not to apply, save in rare instances, by the evidence accumulating in the tests carried on upon so colossal a scale. . . . He would welcome, with the eagerness of any lover of truth, any confirmation of law, for his whole life is pledged to law. He had no ulterior purpose in disproving Mendelian laws: in point of fact, he had disproved their universal applicability years before he knew they existed. Mr. BURBANK, in another instance, has brought to light the absurdity of reasoning from inadequate data. Leading scientists have maintained, and their followers have added the weight of their evidence, that 'acquired characteristics are never transmitted.' In the limitless fields of operation before him, Mr. BURBANK has not only disproven this over and over again, but has established the opposite, that acquired characteristics are the only ones that are transmitted."

I do not mean to deny that the book related many of the actual happenings in BURBANK's professional life. It did. But most of these happenings were served up in a decidedly misleading manner. I cannot exactly say that they were falsehoods, because they were all based on facts; but they leave a false impression. The harm done by HARWOOD's writings about BURBANK has therefore been of an insidious nature, such as a tricky lawyer likes to defend in a court of law because it is difficult to prove the absolute falsity of the statements. For example, in speaking of the Paradox walnut produced from crossing the cultivated English walnut with the native Northern California Black walnut, which did grow much more rapidly than other walnuts, he says:

"At the end of 12 years each tree will be worth approximately \$80. The acre yield would be \$2880. For an average farm of 160 acres the revenue for the 12 years with no outlay, save the cost of planting (not over 25 cents per tree), taxes upon the land, and interest on money invested, would be a little over \$460,000. This does not take into fact the value of the branches and the refuse slabs of mill sawing which would amount to at least four cords per tree — about \$24,000 for the total trees or a grand total for the 160 acres for lumber and fuel amounting to \$485,000."

Sounds like a page out of Gulliver's travels, does it not? But who could disprove it? We might think that no one in his right

LUTHER BURBANK
SANTA ROSA, CALIFORNIA
U. S. A.

January
Twenty-four
1 9 2 0

Mr. M. Sharpe,
Vacaville, Calif.

Dear Sir:

The "Gigantic" plum and the "Discovery" are wholly and absolutely different, the "Discovery" being the best plum of the two by all means, though "Gigantic" is immense. If the wood is not too far along I will get you some next time I go to Sebastopol, and will send you an "Elephant" Quince, though I have only two or three left.

The "Cazique" is the best growing plum of the hybrids, even grown in my nursery. I have no "Epoch" plum wood.

The wood and trees will be sent you as soon as possible.

Respectfully yours,

Luther Burbank

TEXTFIGURE 1.—TYPICAL BUSINESS LETTER AND AUTOGRAPH OF BURBANK.—MILLARD SHARPE, nurseryman, fruit grower, amateur breeder of fruits and an authority on plum and cherry varieties, was acquainted with Mr. BURBANK for twenty years; often visited his experimental gardens, and made a point of testing his new fruits as they were announced. An expert himself, SHARPE greatly admired BURBANK's skill and acumen, both as a propagator and a breeder.

mind would accept such an absurd statement, but unfortunately there were plenty of people who would accept it. For the most part, people with no experience whatever in agriculture thought they saw a chance to make a fortune overnight. But this was not the worst harm that was done: it was in the way BURBANK's experiments were described, which resulted in the production of hybrid plants. Whether or not they possessed intrinsic value was of less importance than the alleged mysterious way in which the experiments were performed: for there is no mystery about the crossing of two plants, the hybridizer is no magician, and it is a shame that a legend should grow up around an individual that could make him a magical figure. Scientists and other informed people were disgusted and immediately branded BURBANK as a faker because they said we are not living in an age of miracles, meaning that anyone claiming to be in league with the supernatural lays himself open to grave charges.

On top of this BURBANK was portrayed by various writers as a man of sweet disposition, a sort of little Lord Fauntleroy grown-up, that took him completely out of the ranks of work-a-day men. As a matter of fact, BURBANK had enough faults along with his virtues to make him human, but HARWOOD set the pace in portraying him as a man of mystery with his head in the clouds so that others felt that they must trail along and not spoil the picture.

Teachers of children have ever sought noble characters to hold up as heroes for them to emulate, and BURBANK's life supplied material in abundance for this purpose. No harm would have been done by depicting him as a noble character, but coloring was added that eventuated into his becoming a cult. Elementary teachers everywhere found his life and works to be just about perfect for their purposes.

When I first began my BURBANK studies, I experimented with my college students by asking them about BURBANK. I soon discovered that all had approximately the same information, and their views of BURBANK fitted into a certain pattern. Upon closer inquiry it was found that most of them had obtained such information as they had from instruction received when they were 11 or 12 years old. Having traced most of their information to the grammar school teacher, I then made a wide survey of elementary teachers and found that the BURBANK fictions began to be disseminated along about 1905 and that a whole generation of men and women have grown up with their grammar school instruction as the only information they have about the man. Here and there a boy would confess that when he got into high school and started to study science, he began to doubt some of the ideas he had acquired in grammar school. In college, these boys came into contact with instructors who belonged to the ranks of modern geneticists, where they were given an entirely new picture of BURBANK, which in most cases was as far wrong as their first one.

There are literally tens of thousands of children who are indoctrinated with the BURBANK fairy story every year, and I can

see no end to it. Rightly guided there is nothing serious about this, but it is unfortunate that a whole population should be allowed to grow up with false notions about a man who was really useful in his generation. Many of these people in later life hear the other side of the story, and the effect upon them is that of a boy who loses his childhood faith in religion — that is, he is apt to become a cynic.

I originally embraced the fond hope that I could bridge the chasm between the extreme admirers of BURBANK and those who deprecated him. But the trouble, I found, was that when we worship a hero, we do not care to have our idol shattered; and if we have heard a man condemned often enough to bring belief, we do not relish having proof thrust in our faces that we are all wrong. Fortunately, there appears to be a host of people who have no violent feeling about BURBANK one way or the other and who merely want the honest facts about the man and his life work, his value to human society as a whole, not alone to the science of plant breeding.

It has been my purpose to try to supply this information, but in so doing, I am surely aware of the fact that what I shall say will not please either faction. However, I console myself with the thought that hereafter trained readers at least will follow the scientific plan of studying all sides of a man before making up their minds about him. If I shall have supplied information not heretofore obtainable about BURBANK that will help students to arrive at their own conclusion after all evidence is in, then I shall feel that I have not labored in vain.

## II

## THE BACKGROUND

FEW MEN in private life have become so widely known as was LUTHER BURBANK of Santa Rosa, California. Through the printed page and by word of mouth the name has been disseminated the world around. The name is always associated with plant improvement or the production of new varieties of fruits and flowers. Legends have grown up about him and his ability to do marvelous, if not impossible, things with plants. Careless writers and speakers have woven so many fairy tales around the name and fed them so widely to innocent children, as well as to ignorant and uninformed adults, that the present generation is faced with the dilemma of swallowing the stories whole or rejecting everything it has heard about the man. By and large, the thinking members of the public are kindly disposed toward BURBANK, but incredulous. Sometimes they are downright suspicious. But the great majority would like to have the facts because they are frankly curious. They want to know what the man was like, about his home life, his daily work, his relations with other people, and whether he was human or a freak. Special groups want to know about his horticultural attainments and techniques. Still others want to know what percentage of his output has made good. The final question — and it is clear that it was often uppermost in the minds of all — was whether he was an honest man or a trickster.

When I first came to California, eleven years before BURBANK's death, I received numerous letters from friends in the Eastern and Middle States asking me for information about the man. At that time I had a rather wide acquaintance in horticultural circles throughout the regions mentioned and these friends believed or hoped that I was in a position to give them the low-down about BURBANK. I went to see him and also talked with my associates. They were not very informative. Their smiles were misleading. Without background of the BURBANK situation, I now realize that they were smiling at my ignorance and seeming naïveté. The main era of BURBANK's exploitation was then at its peak. A newcomer couldn't be expected to understand — and didn't.

Unfortunately I did not make use of my opportunities by starting my studies of BURBANK and his horticultural accomplishments while he was still alive, for much salient information is now lost, particularly leads that might have enabled me to trace many of his hybrid plant productions that were sold unannounced and without names. Also I might now have a better picture of the man himself. On the other hand, I might have fallen into the rut

that other interpreters had followed which has not proven to be very helpful to a world that is still befuddled. The objective view is often best, so I console myself with the thought that perhaps a truer evaluation of the man can be made now, nearly two decades after his death, even with some data missing, than would have been possible while he was still here to give information, but with the greater danger of having my judgment warped by personalities. A shrewd man who had successfully battled his way to high places in political life once warned me never to undertake to judge a baby show while the infants were being held in their mother's arms!

After all, BURBANK's output of improved plant forms was so extensive that I feel the few score, or possibly few hundreds, of forms that I have not been able to find records of would not materially change his rating. But just what he produced or how many of this, that, or the other he turned out is not the big question in the minds of the multitude of people who want to know about BURBANK. No, indeed. For example, in 1931 a controversy about BURBANK arose in the public schools of a large city on the Atlantic seaboard. A science teacher happened to pass a room where a primary teacher was telling her class of little folk about LUTHER BURBANK. The first words that reached him arrested his attention and he stopped to listen. The things he heard rooted him to the spot in amazement. When the class was dismissed he took the lady to task, telling her that although he did not claim to know anything about BURBANK — in fact, was only barely familiar with the name — he was quite sure the things she had been telling her children could not possibly be true, that we were not now living in an age of magic and fairy tales, etc., etc. The lady was very indignant, claimed that she was right, and advised the man to study up on BURBANK and inform himself on the marvelous things that he had done. Other teachers took sides in the argument and the battle was on. For the most part it was the men *versus* the women teachers. The arguments of the former were based upon rationalism while the latter defended their position on sentimental grounds. The controversy was finally referred to the principal who, in bewilderment, pronounced that both sides could not be right and referred the question to Professor L. H. BAILEY of Cornell University; he promptly passed it on to me with the helpful suggestion that I was located in California and quite near BURBANK's home, and therefore should be in a position to obtain the facts about the man and his accomplishments!

I sent a letter to the principal in which I sketched the highlights of the controversy about BURBANK that had prevailed throughout the United States and a few foreign countries many years earlier and pointed out that neither the admirers nor the disparagers of BURBANK were entirely right, that the truth lay somewhere between the two extremes. My reply evidently checked this particular controversy (as I heard no more about it) but I dare say no one was convinced. The incident, however, served to crystallize a thought that had been forming in my mind for some time, namely,

that it was high time that some one obtained the facts and made a fair and impartial evaluation of BURBANK and his accomplishments. What a job this would have been for the master hand of Professor BAILEY! But he was not available and I reluctantly undertook the task. This was in 1932. For five years I did what I could, working part time; then in 1937, having been relieved of some of my official duties I took up the work in earnest.

My personal acquaintance with Mr. BURBANK was limited to a one-half day visit with him in the summer of 1915. Although for thirty years I have resided near the BURBANK place (86 miles distant), I do not believe anyone can successfully accuse me of personal bias because of my relative proximity to the man and his establishment. Also I can affirm that my mind has always been free of prejudice. As a student at the University of Missouri I was chiefly under the influence of the late Professor WHITTEN of beloved memory, who never uttered an unkind word about anyone because in his great soul there was no room for malice or envy. Even when the country was flooded with the literature of the so-called Luther Burbank Society about 1912 or 1913, which was misleading and quite evidently insincere, he remained calm and allowed all of us to draw our own conclusions, if any.

When I came to California in January, 1915, I cannot recall that I held any definite opinion of BURBANK, but I was mildly curious. The one time I called upon him satisfied much of my curiosity. He frequently announced that he did not want visitors unless they came by appointment and then they would not be admitted to his experimental grounds at Sebastopol. I did not seek an appointment because of the possible use he might make of my connection in his advertising literature; not that I was a notable, but the institution I served was.

While I knew in a general way that the high-powered promoters and exploiters of BURBANK — the Luther Burbank Company and the Luther Burbank Press — were then in process of defaulting, with a train of disillusioned stockholders mourning their losses, I did not know how the BURBANK business was being conducted; and as it was more or less in disrepute, I thought the safe thing was to keep away.

Perhaps, as I now look backward, I was unduly alarmed, but I was particularly sensitive at the time as I had just passed through the experience of being tricked by a conscienceless promoter into a seeming endorsement of a shady land selling scheme. I visited the place in a private — and as I thought, anonymous — capacity, but he accidently discovered my identity and used me, or rather the University, accordingly. Also I had been imposed upon a few years earlier by a large nursery that was rated as respectable, but which was given to making unduly extravagant claims for its wares.

Then there was the case of Professor E. J. WICKSON, who was head of the Department of Horticulture in the University of California and for many years Dean of the College of Agriculture

# NEW CREATIONS

IN

# Fruits and Flowers,

JUNE, 1893.

KEEP THIS CATALOGUE FOR REFERENCE.

You will need it when these Fruits and Flowers become standards of excellence.
Supplementary Lists will be published from time to time.

---

## BURBANK'S EXPERIMENT GROUNDS,

Santa Rosa, California, U. S. A.

Office and Residence:
204 Santa Rosa Avenue.

Cable Address:
"Burbank, Santa Rosa, Cal."

"New Creations in Fruits and Flowers, June, 1893." — This 52-page, illustrated catalog was the most important announcement ever made by Burbank. His fame as a plant breeder was now established, both nationally and internationally. Ten or twelve years earlier when he first began sending out his new fruits, buyers were hesitant because he was unknown. Now with the announcement of many new hybrids, scientific men began to take notice and enterprising nurserymen were anxious to procure some of the things that were being so widely talked about.

In his next year's catalog (1894), under the same title, Burbank reviewed the situation as follows: "Twelve months have passed since the first number of 'New Creations in Fruits and Flowers' was sent out on its mission among dealers in trees and plants, great care being taken to confine it to the trade only; but before the few hundred first published were all delivered, orders came pouring in with each mail, like the falling of autumn leaves, for more, more, and again more had to be printed, and to this day the requests for 'New Creations' are increasing rapidly, instead of diminishing, as it had been hoped they would.

"Probably no horticultural publication ever created more profound surprise or received a more hearty welcome. Almost every mail brings requests for them from colleges, experiment stations, libraries, students, and scientific societies in Europe and America, and it has been translated into other languages for foreign lands, even where it would seem that scientific horticulture was hardly recognized; some asking for one, others for two or three, or a dozen or two or more. We cannot attend to the ever increasing avalanche of letters which they occasion, a large portion of which are from amateurs, with long lists of questions, which would require years, perhaps a lifetime, to answer.

"This ever increasing number of letters, which we have always carefully replied to (some twelve hundred to two thousand per annum), must be stopped, in part at least, else there will soon be no one here to answer them. We love to produce new fruits and flowers, and our heart is made glad beyond expression to know that our work is appreciated far and wide; but most of the *questions* which amateurs ask could better be answered by some horticultural paper, which would welcome them, or some one who has more leisure at his command . . . .

"We would very much prefer to have all our new fruits and flowers fully tested everywhere and by everybody [before sending them out]; but those who know the facts are too well aware that it would be a perilous risk or utter ruin to the originator, as a single bud or seed in the wrong hands may place an unscrupulous person on an equal footing with the originator, who may have spent worlds of patient thought and toil, during the few short years of the best of his life, in producing the beautiful creation . . . . .

"Do not imagine that because the purchaser of the control of any of our new fruits and flowers happens to be so enthusiastic as to overpraise them, painting their virtues in far brighter colors than we have done, that the originator should be blamed. Great loss, vexation and disappointment come from indiscriminate and unwarranted praise . . . ."

and Director of the Agricultural Experiment Station, as well as editor of an agricultural paper. From the very beginning he seems to have been very friendly toward BURBANK and sympathetic toward his work, visited him, wrote many articles about his work, all highly laudatory, and was honored by BURBANK who named a plum after him. These relations continued until a few years after the turn of the century when WICKSON seems to have dropped his friend. Whether the extensive use of his name in the BURBANK advertising literature had anything to do with it I do not know, and it is now too late to find out. However, that was the gossip among his colleagues, who, in truth it must be said, were not acquainted with BURBANK and did not care to be; although, they were curious and would have liked to have seen BURBANK and his place but were afraid of being used. Perhaps WICKSON liked to have his name used so widely. I am inclined to think that he did. As a newspaper man he presumably believed in publicity. He was not a scientist *per se* so he had none of the inhibitions of the scientist regarding personal publicity. But along about 1910 or 1912 or thereabouts, he seems to have tired of it and ceased both his writings and his visits.

When I visited BURBANK I went with a party of three or four members of the American Pomological Society, who were in California to hold their annual meeting and visit the Panama-Pacific Exposition then being held in San Francisco. These men, who had made an appointment to see BURBANK, had to leave after an hour or so, but I wanted to stay longer. In leaving they introduced me as being from the University of California. BURBANK was exceedingly cordial — more so than before — and immediately undertook to entertain me by showing me all the interesting things in the old home garden. Then we went across the street to the roomy, two-story house which he had built in 1907, "from the proceeds of a sale of spineless cactus to a dealer in Australia," and which was his residence for the remainder of his life. Here he showed me how he kept his seasonal records of some apples he was just then particularly interested in, as well as the system of marks and hieroglyphics he used in noting the different grades of approval or disapproval of other fruits under trial, but if he kept any permanent records or yearly summaries, he did not show them, and as far as I could see he kept no written account of the parentage of his crosses. He left me to browse among his records — more properly, random-notes — while he attended to some matters with his secretary. This young lady, I might mention in passing, did not look upon my presence with approval, and when we started for the yard another secretary, this time a young man, said something to Mr. BURBANK which he dismissed with a wave of his hand.

The house occupied a corner lot, and I noticed that both sides of the intersecting streets were lined with cars and a great crowd was milling around looking over the low picket fences but not daring to enter either of the gardens. As we came out Mr. BURBANK was the cynosure of all eyes and the visitors lined up against

the fence on our side of the street to gaze upon him. As we moved about examining this and that tree or shrub I was ill at ease and embarrassed because I felt unworthy of so much attention. If BURBANK was in the least self-conscious he did not show it; on the contrary, he seemed to enjoy the situation. I soon noticed that a male secretary was hovering around as though he would like to speak to Mr. BURBANK. I say "hovered" because he forcibly reminded me of a negro in the "black belt" of Texas when he wants to say something to a white man but must wait for an invitation. At length BURBANK looked his way and curtly asked, "Well, what is it?" The young man came closer and whispered something but was impatiently dismissed with some remark to the effect that he was busy and could not be disturbed. Noticing how crestfallen the man was, I seized an early opportunity to say that I must be going. Then BURBANK broke out pettishly that he could spend as much time with a visitor as he wanted to, that I was from the University and had never been there before. Then, "Why haven't you visited me before? Why is it you people don't visit me oftener? Professor WICKSON used to come to see me and now even he doesn't come any more. What have I done, etc., etc. " I had noticed out in the street a huge, shiny car, with a man dressed in a morning coat and top hat, surrounded by an escort of men also in formal dress, and in my confusion I sought to change the conversation by remarking that some distinguished visitors wanted to see him and that I was taking altogether too much of his time. Without looking around, he remarked, "Huh, that's only the Governor of Pennsylvania; let him wait." He then began to explain, and it was really pathetic — though naïve — that so many people came to see him through curiosity only that he felt like a monkey in a cage, that he was sick and tired of it, and that now, while the Exposition was going on, there were simply swarms of them. "What am I to do? If I undertake to see them I can do no work, and if I turn them away they are resentful and say unkind things about me. How am I to know when I am turning away people that I would really like to see? You didn't make an appointment with me today, and you might have been refused admittance. How am I to know? What am I to do?"

Previously, during the hours I had spent with him, he had been cheerful and in good spirits and positively glowed as he described the superior qualities of some of his "creations", but now as the hopelessness of his situation came over him, he looked tired and discouraged — like an old, old man — and I felt sorry for him and deeply sympathetic.

## III

## BURBANK THE MAN

IN PERSONAL appearance BURBANK was of medium height and build with florid complexion and a full head of hair. He was referred to by DE VRIES and others as being small or slight, but in my limited acquaintance with him he did not impress me as being either small or slight, but just medium. As a matter of fact, his widow tells me he was about 5 feet 8 inches tall and weighed around 150 pounds. While not very robust, he was wiry, highly sensitive, always alert, and inquisitive. He referred to himself at the time he arrived in California, when he was 26 years old, as being a "small, wiry, active young man." One of his biographers[3] described him, when he was near the end of his long life, that is, at the age of 76, as being "small, live, and slightly stooped; his eyes a deep, placid blue. Of a nervous temperament and with a vital, compelling personality, he always impressed visitors with his sincerity of purpose."

All his adult life he was playful, whimsical, sometimes grumpy, and from the middle eighties on became increasingly egotistical. Under normal conditions his disposition was mild, even gentle, but persons who have worked for him say that on occasion when exasperated at someone's carelessness or stupidity in injuring or destroying a valued plant, he might fly into a passion and use forceful language with an earthy flavor befitting the circumstances. WILL HENDERSON, who worked for BURBANK from 1922 until the latter's death in 1926, relates[4] that they were discussing some matter out in the yard one day when a man leaped the low picket fence, rushed up to the pair and, sticking out his hand, exclaimed: "Well, well, this is Mr. BURBANK, I am sure, and I am so glad to meet you and I suppose this is the young man who is to be your successor, is it not?" BURBANK glared at the intruder, and snapped out, pointing to the gate, "It's none of your damn business and get the hell out of here."

WALTER B. CLARKE, a California nurseryman, tells me that in 1909 he spent three or four months in Santa Rosa as sales manager for EDWARD LAW who headed a company which had a contract to market BURBANK'S products. When BURBANK repudiated the contract and the company was dissolved, he remained as sales manager for BURBANK until that contract also was repudiated. A florist by profession, CLARKE reflects the prevailing opinion of the florists of his time. He says: "From the first I did not have a

[3] WILBUR HALL.
[4] Personal conversation, 1937.

very exalted opinion of BURBANK as a plant breeder. He was erratic in his actions and slip-shod in his methods. He was a strange combination of childlike simplicity and Yankee shrewdness. Loving publicity and craving recognition, he was very susceptible to flattery and already in 1909 had begun to believe all the favorable things that were said about him. An example will illustrate his erratic behavior: The busy season was at its height, and BURBANK was fuming because of interruptions in his work — visitors, correspondence, office duties. He finally walked out on them all, leaving the impression that he was engaged upon one of the most important tasks of his life, so they let him go without protest. But I, as sales manager, simply had to see him regardless, therefore, followed him across the street to his other place and found him there, hidden behind the house planting a row of sweet peas, a job so trivial that any boy could have done it because they were not being planted as an experiment but for ornamental purposes. I felt hoaxed and did not recover from the shock for some time.

"I did not take much stock in his claims of being able to judge the value of an ornamental before it flowered or a tree before it was old enough to fruit. Believing this, might account for his habit of selling things before they were adequately tested. He did however, have a discerning eye for racial and varietal characteristics and could, probably, in many instances, pick out and correctly name the right staminate parents of his seedling hybrids. He really was good at this."

I set a high value on the evidence of Dr. GEORGE H. SHULL who spent approximately five years (1906-1911) with BURBANK as the representative of the Carnegie Institution of Washington. This was perhaps the most trying period of BURBANK's life as he was the recipient of a subvention ($10,000 a year) from the Foundation and felt that he must make good, but he found the necessary changes in his working habits to be vexatious in the extreme. However, he coöperated to the best of his ability which is saying a good deal for a man who had always worked alone and was proud of his independence.

"As to Mr. BURBANK's personal habits," writes SHULL,[8] "I would like to say that he was certainly not naturally inclined to profanity. . . . It is my impression from an exceptionally long relationship that he was a man of the finest, cleanest character of any person I have ever known. I always felt that he was the sort of man who *deserved* to be a popular hero. He was not a man to cater to any sort of temporary social blandishment. He was an individualist from start to finish. Meeting people was one of the most distasteful processes which he ever had to endure." He then related how BURBANK was once inveigled into riding in a carriage with a woman in a local rose carnival. "He went through with it, but in expressing his feelings afterwards he gave the most convincing proof that the performance had disgusted him to the point of nausea."

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[8] Personal letter to the author, November 25, 1939.

As a young man he must have been even-tempered, mild-mannered, and anxious to please, but as he grew older and was weighted down with cares he became peevish and eccentric. He called himself an "old growler", meaning that he was given to grumbling. Some of his grumbling was pose because he loved to act a part. But it was also a foible. There is no doubt that he fussed over little things and at such times indulged in make-believe faultfinding. It was hard to tell when he was really peevish or merely whimsical. This was particularly true of people not acquainted with him, but he was given to peevish outbursts, gave voice to both real and imaginary grievances. Throughout life he appears to have been addicted to making extravagant statements. One of his biographers[6] who knew him rather intimately says that "numbers meant little to him, that he liked to roll large figures on his tongue." This, coupled with his natural self-esteem, plus his tendency to dramatize a situation, will explain some of the big and little incidents of his life.

It is not generally known that BURBANK was twice married. His first venture occurred when he was a little past forty, a highly susceptible age for a man. On one of his transcontinental trips he met on the train a youngish widow by the name of HELEN A. COLEMAN. She appears to have been favorably impressed with him and he, in college boy parlance, "fell for her hard." She quickly followed him to Santa Rosa and remained there until they became formally engaged. BURBANK purchased a horse and a fashionable carriage (technically known as a phaeton) and entertained her royally for about two weeks when they went to Denver, Colorado, her home, where they were married on September 23, 1890.

Report[7] has it that HELEN was "queer" from the beginning, and many thought she was off-balance, mentally. She was peculiar in her dress and speech and even at home her manner was silly, simpering, and affected. She had the reputation of being an adventuress, but BURBANK was crazy about her. From the beginning she was jealous of BURBANK's mother who lived with him and was then nearly 90 and had been living with LUTHER for over 20 years. HELEN declared that she (his mother) "was a vile serpent, an old vicious cat, and that LUTHER and all his relations were a nest of cats and snakes and low-lived dogs." What she was trying to accomplish was to get rid of all his relatives — mother, sister, a brother or two, and perhaps others. She became a termagant—a confirmed scold.

BURBANK loved children and liked to play with them in his yard while HELEN detested them. She humiliated BURBANK by upbraiding him and ordering the children away in tones loud enough to be heard by the neighbors. She nagged during the day and quarreled at night. The climax approached when she slammed

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[6] HALL, WILBUR, Harvest of the years. Houghton Mifflin Company, Boston, Mass., 1926.

[7] Personal conversations with persons who knew her.

a screen door on him one day and blacked his eye and a little later jumped up in the night and threatened to shoot him.

He then took up his abode in a room over the garage — a workroom, afterward called the studio — where he could lock himself in at nights and have some degree of peace. This arrangement continued for two years. All the while he was carrying a heavy load of work in addition to the burden of his domestic infelicity, for this was the period when he first began to really attract world attention by his attainments. Under the double load his health failed and he almost became a nervous wreck. He finally sued for divorce which was granted October 19, 1896. HELEN's lawyer made no attempt to answer BURBANK's charge of inhuman cruelty and incompatibility. With characteristic generosity BURBANK voluntarily made her a liberal property settlement.[8] She returned to Denver and thus passed out of his life.

BURBANK's second matrimonial venture occurred on December 21, 1916, when he married his secretary, Miss ELIZABETH WATERS. Although he was 67 and she in her middle twenties this marriage, to the end of his life, appears to have been a peaceful one. The second Mrs. BURBANK, a quiet, well-preserved, young-looking woman, still lives in the BURBANK home.

From what old Santa Rosans tell me BURBANK never cared to cultivate the social graces. Mrs. OLSON,[9] a contemporary of BURBANK, when well past ninety, said of him that he was always awkward and ill at ease at social affairs; that his mind at all times was centered on his work, and not wanting to talk shop, he had nothing to say, so was always fidgety when in company away from home; and that he led a very abnormal existence when a young man in that he never had any women friends.

Mrs. OLSON was several years older than BURBANK and knew him for fifty years. Two of her daughters, Miss PAULINE and Mrs. E. C. MERRITT, did clerical and secretarial work for him off and on from 1900 to 1912. They describe him as being, ordinarily, a shy, diffident man but highly egotistical; that he never would admit he was wrong about anything; that he was careless, sloppy, and unsystematic in his business affairs — in fact, a poor routine business man. Still, he was shrewd, sincere and fundamentally likeable for his many fine qualities and they admired him, though they regretted he was easily imposed upon by designing persons, especially women.

I have talked with several persons who worked for BURBANK at different periods from 1887 to 1926. One of the earliest of these was Dr. D. B. ANDERSON, who still practices dentistry in Santa Rosa, and who did secretarial and accounting work of evenings at BURBANK's home. This was from 1887 to 1889. He found BURBANK to be affable and kind, modest and retiring in some ways but extremely egotistical in others. He was given to periods of

[8] LUTHER BURBANK *vs.* HELEN C. BURBANK, Case No. 4265, Court House, Sonoma County, California, 1896.

[9] Personal conversation.

FEBRUARY, 1892.

# New * Gladioli

LITTLE GEM CALLA.

Clematis, Shade Trees, Japan Walnuts, Bulbs, Etc., Etc.

## LUTHER BURBANK,

SANTA ROSA, - CALIFORNIA.

**BURBANK'S EXPERIMENTAL GROUNDS,**

**Office: 204 Santa Rosa Avenue. Branch at Sebastopol.**

☞ **Special Express Rates.**—It is always better to have trees and plants shipped by express, unless the amount of stock ordered is large. The Wells, Fargo Express Company carry my trees and plants on all their lines at *special low rates;* by this reduction packages weighing less than one hundred pounds are generally delivered anywhere in the United States, and often in foreign countries, for less than by freight, besides always going more safely and speedily.

**All Goods are Carefully Packed** by experienced men, for which a charge only sufficient to cover cost of material and labor is made, and delivered in good condition to the forwarders, after which my responsibility ceases.

**Terms Cash.**—*No goods will be shipped unless cash or satisfactory security accompanies the order.*

Remittances may be made by bank drafts on San Francisco, post-office orders, express or registered letters.

TEXTFIGURE 2.—COVER OF AN 1892 CATALOGUE.—BURBANK successfully crossed the Crozy type canna with the wild swamp canna of Florida, *Canna flaccida,* to produce the so-called orchid canna. The Burbank and Tarrytown varieties were popular for many years.

self-exaltation. For example, he once compared himself to NAPOLEON by saying: "See, I am about the same height as NAPOLEON and my hat is about the same size as his, although my head is growing and increasing in size all the time," an intimation that his increasing mental development was making his head expand although he was then about 40 years of age, and it would have been remarkable indeed if his head really were still growing. This might have been a BURBANK whimsey, an act put on to impress young ANDERSON, but the latter does not think so.

This was at the time when he was highly successful as a nurseryman, with a net income of $10,000 or better. His gross sales in 1897 were above $16,000. He certainly had a right to feel proud of his success as a business man. But it was not pride of money coming in that exalted him but the far greater satisfaction of having demonstrated to the members of his family that he was a man in his own right, a man of ability, for in all his earlier years in Massachusetts he was thwarted and discouraged by these same people when he showed a tendency to strike out along new lines. In fact, he makes it clear in his writings of later years that the principal reason for going to California was to get away from these discouraging influences and start life anew where he would have complete freedom of action. Also he was disgusted with the warfare of the churches in New England against DARWIN's books and he wanted to be away from it.

A minor influence was a love affair. Writing about this fifty years later he says, or is made to say:[10] "The story of this early romance of mine has crept into the newspapers now and again; the truth is that I was deeply fond of a beautiful young lady who, as I remember, was less ardent than I was. . . . I determined that my heart was broken. To be frank, I think I gave that affair to many as my reason for coming West . . . . it was the proximate cause, probably the turning point. . . . I find on looking back that there was another motive behind my decision. . . . I was undoubtedly influenced by a desire to be my own man, unadvised by family or friends and no longer compelled to apologize or explain my choice of work. . . ." It is probable that MARY, for that was the young lady's name, being of conservative New England stock, considered young BURBANK to be a dreamer and that he could never make a living for a wife.[11] Others thought so too but not LUTHER. He seems always to have had an abundance of confidence in himself

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[10] HALL, WILBUR, Harvest of the years, 1926.

[11] I obtained many side lights on BURBANK from Mr. W. I. BEESON of Healdsburg, California. Mr. BEESON married EMMA BURBANK, LUTHER's sister, and they lived together for forty years. During most of this time she was her brother's devoted helper and adviser. Concerning the girl BURBANK was said to have been in love with in Massachusetts, Mr. BEESON has this to say: "The name of the girl was Miss MAY (MARY) CUSHING and I know for a fact that they were only neighborhood friends. He may have admired her and she may not have encouraged him, but that was all there was to it. He never asked her to marry him so she had no opportunity to reject him. Miss CUSHING married a man named W. S. BARTLETT in Massachusetts. She talked this matter over with us when she visited in California in 1936 or 1937. She is now a widow."

and it is understandable that with the coming of material success he felt the urge on occasion to strut or brag; but he had another urge aside from making money and that was to experiment with plants with a view to their improvement. He had to prove to MARY and the members of his family that he could carry on a business enterprise successfully — something they could understand.

Of this period BURBANK is quoted as saying:[13] "CHARLES DARWIN's *Cross- and Self-Fertilization in the Vegetable Kingdom* was published in 1877 and it was not long before I had a copy. I had spent my first months in California studying the country, comparing various localities as to suitability for my purposes, earning my way with whatever came along to be done and experimenting with plant development. I soon knew most of the native plants and herbs that came under my notice. . . . One sentence in the very introductory chapter of that volume opened the door of my mind and took possession of my fancy. After discussing briefly the marvel of cross-fertilization in plants DARWIN said: 'As plants are adapted by such diversified and effective means for cross-fertilization, it might have been inferred from this fact alone that they derived some great advantage from the process; and it is the object of the present work to show the nature and importance of the benefits to be derived.' Advantages and benefits! DARWIN was writing of the plants themselves — I was thinking of mankind. If Nature had developed an incredible system by which plants could re-create and diversify and improve themselves *for their own benefit* and advantage, why should not Nature be induced to employ that same system *for the benefit and advantage of man?* It was my starting point. . . . DARWIN had experimented with pollenization, but only for the purpose of discovering and setting down laws. He made important and absolutely new findings, but when he had made them and set them down he left it to others to make the rules useful."

Now he was determined to follow his own private star of destiny into this other field of his ambition. The chief food for this urge was his own curiosity and belief that he could accomplish things not yet discovered — his imagination having been fired by reading DARWIN's books — but there must have been still some other stimulus. It appears from some of his writings that his mother always had confidence in him and doubtless encouraged him to follow his bent, not only because it would make him happy but because she believed in him. And it is highly probable that he also cherished the ambition to confound the scoffers of his youth who had frowned upon his efforts in plant improvement as something that he had best leave alone.

BURBANK was of New England stock but not of the extreme Yankee type like CALVIN COOLIDGE. For example, he was not taciturn and had no nasal twang. The COOLIDGES were proud of the fact that none of them ever went west while the BURBANKS, most

[13] *Ibid.*

of them, migrated to the far west and were not ashamed of it. COOLIDGE, to be sure, was born in the Green Mountains of Vermont but spent most of his life near Northampton, Massachusetts, perhaps 20 miles from Lancaster, Worcester County, which was BURBANK's birthplace and near where he grew to manhood. Being the 13th child in a family of 15 in a middle-class household, where money was none too plentiful, BURBANK absorbed qualities of thrift, industry, and self reliance. His love of horticulture he seems to have inherited from his mother, SAMUEL W. BURBANK's third wife.

Contradictory stories galore have been published about BURBANK's disposition. Some visitors have pictured him as gentle, kind, even angelic; others that he was grumpy, brusque, tactless. Conflicting reports have made the public curious. I have conducted surveys in which I contacted hundreds of people, high and low, to obtain their views of the man. Some had visited him in Santa Rosa while others had formed their opinions from reading or from something said by friends who had met him. These views which have been extensively published or passed along by word of mouth fall into three categories: that he was affable, peevish, or downright rude.

After obtaining the details of a goodly number of cases, I believe I can understand how such a diversity of views or impressions came into existence. BURBANK's every instinct was to secure as much favorable publicity as possible. He particularly craved the approbation of known scientists and representatives of scientific institutions. To him it was all one — whether they came out of curiosity or to study his accomplishments. He chose to believe that they came, one and all, because they approved of him. Never too busy to give time to the notables of the land he welcomed visits from princes, Maharajahs, and captains of industry because publicity came in their wake. To all of these he was the perfect host and was affability itself.

Then there was the rest of the world that came by the hundreds and thousands. Most of these were admirers and came for self-gratification and a bit of reflected glory like shaking hands with the President or with royalty. There were in the aggregate comparatively large numbers of teachers, students, farmers, fruit growers, nurserymen, and the small fry from colleges and other institutions, all with more or less technical knowledge of plant culture. These were the people that seemed to irritate BURBANK. They frequently insisted on cross-questioning him or trying to tell him something when he wanted to do the telling himself. Some of these undoubtedly wanted to criticize or find fault, to get something on him. But the greater majority were well-wishers and many of them potential customers for his wares. There was scarcely a nurseryman or seedsman who did not like to list a BURBANK product as a leader in his catalog.

And, too, there is always a sprinkling of honest people throughout the country, who have accomplished something on a small scale

themselves in the way of originating a new fruit or flower, and naturally want to sit at the master's feet and tell him about it, sometimes for their own aggrandizement and sometimes merely to demonstrate to BURBANK how much they understand him and appreciate what he is doing. But unfortunately, BURBANK is too busy to see them and the visitors are prone to think they are being ignored and, depending upon temperament and past relations with BURBANK, to put the worst possible construction on his motives. Some will fight back when they feel they have been slighted.

In the summer of 1906, at his busiest time and when he was reaching new heights of fame — or notoriety, according to viewpoint — BURBANK had a temperamental visitor by the name of O'MARA, representative of a New York seed and floral establishment, whose pride was hurt because he was not received. He went home and published a highly ironic account of BURBANK's achievements,[13] based mostly on the magazine articles of HARWOOD[14] and WICKSON.[15]

Much of what these writers related was the truth but the fantastic manner in which it was served to the reader led many scientists to believe that he was not to be taken seriously. On the other hand, the masses — the great uninformed public — were profoundly impressed by the beauties and wonders portrayed by both HARWOOD and WICKSON, and to them BURBANK became a marvel of Brobdingnagian proportions and a wizard of the first order. This view has prevailed to the present day and promises to survive because it is being taught to the young. For example, Arbor Day in California, March 7, is LUTHER BURBANK's birthday. This is no coincidence as the date was fixed by the State Legislature many years ago to honor an outstanding citizen, in the same spirit that AUDUBON, JOHN MUIR and JOAQUIN MILLER have been honored.

Each state may have its own heroes. State Departments of Education observe Arbor Day by arranging that appropriate exercises be held in all the elementary schools on a certain day in the spring. The primary purpose is the promotion of tree planting — practical forestry — but the California State Department of Education went much farther by publishing a brochure[16] which was designed to idealize BURBANK. This is in general use all over the United States by teachers of elementary science. BURBANK's impeccable moral character; his known love of children; his cham-

[13] O'MARA, PATRICK, LUTHER BURBANK. A short review of his work in plant hybridization and brief comparison with other hybridizers. Florists Exchange, New York, October 20, 1906. Reprinted in pamphlet form under the same title, by the author in Jersey City, N. Y., September 12, 1907.

[14] HARWOOD, W. S., A maker of new plants and fruits. Scribners Magazine, July, 1904. — LUTHER BURBANK's achievements. Country Calendar, Harrisburg, Pa., 1, 3: 244, July, 1905. — A wonder worker of science. Century Magazine, New York, 69: 656, 1905.

[15] WICKSON, E. J., LUTHER BURBANK, the man, his methods and achievements. Sunset, San Francisco, California, December, 1901; February, 1902; April, 1902; June, 1902.

[16] Conservation, Bird and Arbor Day. California State Board of Education, Sacramento, California, Bulletin No. 19, 1917.

pionship of temperance and clean living; all of this, combined with his life-time efforts at plant improvement, make him an ideal subject for interesting children in citizenship, tireless industry, and love of nature.

Neither O'MARA nor his successors made much progress in stemming this flood of sentiment but O'MARA did meet with considerable success in alienating the views of influential people who are usually committed to the practice of correct thinking; and he did it not so much by logic, as by ridiculing the statements of HARWOOD and WICKSON and letting it go at that as though there was nothing favorable that could be said about BURBANK. HARWOOD, it should be explained, was a professional writer of books and magazine articles and was proud of his ability to popularize science by dramatizing it. In his book *The New Earth. A Recital of the Triumphs of Modern Agriculture,*[17] he relates many facts about that industry, certainly, but, following his journalistic instinct, he dresses up his facts in gaudy raiment. By indulging in hyperbole and by stressing the marvelous, he leaves the uninformed reader with an exaggerated if not wholly incorrect idea of the realities of the noble calling of agriculture.

He followed this same formula in recounting BURBANK's accomplishments, by giving the public what he thought it wanted to hear. The sentimental and uninformed accepted everything he told them as facts. There was much truth in his statements, to be sure, but they were distorted. Thinking people were amazed and didn't know what to believe. The informed reacted in different ways. Some merely smiled and consoled themselves with the thought that it was all too ridiculous to worry about, that people would know how to discount such obvious overstatements; while others grumbled, and a few made half-hearted protest but were shouted down — that is, all except O'MARA.

WICKSON, too, did some injury to BURBANK's reputation among scientists because more was expected of him than from HARWOOD on account of his position as Professor of Horticulture in the University of California. As a state official he spoke with considerable authority and they thought he should have been more conservative in his statements. Agricultural officials everywhere had seen loudly-heralded new varieties of fruits, flowers, and vegetables rise and disappear, and they were slow to believe that so many new things WICKSON gave BURBANK credit for could appear in so short a time and be worthy of planting for income purposes. He was much too enthusiastic about them — seemed to endorse the producer's claims *in toto* — and when some of them failed to make good outside of California, they blamed him for his lack of caution, one of the dearest attributes of the scientist.

However, even WICKSON's colleagues in other states did not know or did not realize that he was also a newspaper man. He led a sort of dual life. In addition to his professorial duties he was

[17] Macmillan Company, New York, 1906.

for forty years the editor of the *Pacific Rural Press,* perhaps the most influential horticultural journal on the Pacific Coast. The statements made by Editor WICKSON in his newspaper and, more important still, in his magazine articles were not necessarily couched in the same words that Professor WICKSON used in writing his widely used horticultural books. I mean that his newspaper writings were enlivened by a puckish wit that sometimes caused him to be misunderstood. In writing or in public speech he was witty without effort. He loved to poke fun at people and things. While he grew lyrical in some of his articles about BURBANK he was slyly satirical in others. Also as editor of a farm publication he dared not let his thoughts soar in this technical journal as he would in a magazine. The one was personal, the other impersonal. In presenting a thought to his farm patrons he had to keep his feet on the earth. Time and again subscribers would ask about this or that BURBANK product: was a certain fruit all that was claimed for it by BURBANK or by the nurseryman who had purchased the right to its distribution? And would the Editor advise him to plant it?

BURBANK's establishment was not far away; they were good personal friends; he had written glowingly, but in general terms, about BURBANK's accomplishments; he didn't want to offend. But now it was necessary to speak in specific terms; so he sometimes hedged by speaking in parables; or, in mock serious vein, managed to let the wise reader know that the fruit inquired about appeared to be promising but had not been adequately tested and the reader had better practice conservatism until more information had been accumulated. Many years later he even spoke out plainly when certain things were known to have turned out badly. WICKSON was honest but his outlook was that of the publicist rather than that of the scientist. His faults might be likened to what is known as poetical license. He strove to be entertaining and was, regardless. . . .

A state or national convention in San Francisco was never complete unless the delegates could spend a day in Santa Rosa seeing the BURBANK gardens. Travel bureaus and chambers of commerce encouraged this. Don't forget for a minute that BURBANK loved this public acclaim but it must be remembered at the same time that he was a conscientious worker and earnestly engaged in a cause that he honestly believed was contributing to the happiness, well-being, and prosperity of the world.

Now let us imagine it is the month of July, about the year 1910 or 1911, both busy years as attested by his having issued during each at least eight catalog announcements. For the experimental horticulturist, July is the busiest single month of the year — it is also the month of conventions — because most kinds of fruits are ripening and observations have to be made and recorded, and flower seeds are maturing and must be harvested, dried, and stored. Remember, too, that BURBANK was a one-man institution and rightly or wrongly he rarely or never entrusted to others the task

of making observations and passing judgment on his hundreds or thousands of hybrids undergoing test.

He rises at daybreak, about 4:30, and at 5 o'clock he is at work in his Sebastopol trial orchard seven miles away. Every minute counts. Scores of fruits are ripening, for they are all seedlings and no two alike — there are apples, peaches, pears, plums, grapes, and on this day perhaps a few late cherries; and all must be observed for size, shape, color, and *taste*: and the sun is hot and he is past sixty years of age. By noon he is thoroughly tired and returns home with a sour stomach from sampling too many acid fruits, and finds several visitors waiting to see him. Passing from the garage to the house he runs the gauntlet of outstretched hands and cheery greetings. He bows right and left and impatiently tells the callers he regrets that he cannot stop to talk with them. At the door a man waylays him and grabs his hand only to be thrust aside. Another more daring than the rest follows him into his study and insists upon introducing himself and explaining why he should have an interview. He is asked to leave.

After BURBANK finally sits down to lunch the telephone announces that a party of seventy-five or a hundred persons have arrived in town and wish to be conducted over his gardens. The local Chamber of Commerce secretary protests that the party was sent over by a travel bureau, a plan BURBANK had approved months earlier, and what should he do with them. BURBANK capitulates and the party comes, but he is not a gracious host. Some were grateful for having seen him under any circumstances; others considered him to be peevish; while the few that had forced their attentions upon him and were repulsed said he was rude.

At this point, I ask the reader what he would have done had he been in BURBANK's place. There are two plausible replies. One, that he should have engaged an assistant and trained him to help with the field work; and two, he should have hired a public contact man. Unfortunately, neither of these was possible or practicable for BURBANK. He would not trust anyone to make the selections from his numerous hybrids and the people did not want to see a public contact man or any other man but BURBANK. The great majority of visitors came through curiosity and they much preferred to see the man rather than his productions if they could not do both. As a matter of fact, announcement was made April 30, 1910, that a bureau of information had been established with Miss PAULINE OLSON in charge. Miss OLSON was his secretary. Nothing much came of this plan except that there was now someone to answer questions and casual visitors were not summarily sent packing. They might even feast their eyes on the mighty BURBANK at a distance as he worked in his garden. But this did not suit a lot of people, particularly the self-important, for these, alas, also had an ego to be fed. And in truth, it did not suit BUBBANK either. Although shy in a way and perhaps fundamentally modest he responded to adulation and even hungered for it and therefore could not long deprive himself of this kind of food.

For more than 30 years BURBANK was a world character. Perhaps the name of no king or potentate was so well known; and now (1944), 18 years after his death, the name still lives, and it promises to survive for another generation at least because countless thousands of people now living were taught to revere the name. Doubtless no character in our history, GEORGE WASHINGTON not excepted, has had so many fairy tales spun about his life and accomplishments.

His admirers have pictured him as a wizard, a magician, or a demigod. His detractors, on the other hand, have not hesitated to rate him as a charlatan and a fraud. Very rarely has there been anything like a half-way position, and these widely divergent opinions still exist. For years, I have amused myself by bringing up the question from time to time among acquaintances just to obtain their reactions to the name. In a broad general way, BURBANK all along has been extravagantly praised by ministers, grade school teachers, garden lovers, space writers of the sentimental or sob sister variety, and by those who were selling his wares. He was condemned by rival nurserymen and by some who called themselves scientists. In all fairness, I should add, however, that I have rarely known or heard of an instructor in a biological science who taught his students that BURBANK was a fraud. These instructors were apt to evade the question or to abandon the subject as quickly as possible. The effect was to condemn the man with slight praise. Editors were sometimes on one side of the fence and sometimes on the other, depending upon their bias or some little bit of information or misinformation which might have come their way.

It must be remembered that the world at large secured most of its information from the Sunday supplements and from advertising literature. Space writers universally accepted everything and did not try to ascertain the facts, if indeed they were capable of passing judgment on the merits or demerits of this or that fruit or flower, which I very much doubt. The advertisers — dealers who had purchased BURBANK products — for obvious reasons were usually over-enthusiastic and prone to follow the good old policy of *caveat emptor* — let the buyer beware!

Those who were close to BURBANK in his daily life credit him with possessing a considerable sense of humor, even at his own expense, providing the shafts were not directed at him — obliquely. He couldn't bear ridicule, even in fun. The old gag about his having crossed the milkweed with the eggplant to produce an omelette, his biographer[18] says, "left him cold" because of the implication. However, he did enjoy the ludicrous if it did not reflect on his work, as illustrated by an incident that occurred about 1900. He was opening and reading his mail one morning when he suddenly threw back his head and roared with laughter. He finally explained to his secretary, Mrs. MERRITT — or maybe she then was

[18] WILBUR HALL.

still Miss OLSON — that the letter was from a man in Denver who said he had some time before married HELEN, BURBANK's former wife, but regretted the step and was anxious to be rid of her and asked BURBANK's advice about how to proceed. This so appealed to BURBANK's sense of humor that he doubled up and laughed till the tears ran down his cheeks. He thought it was the funniest thing he had ever heard in his life.

BURBANK was a man of generous impulses and ever ready to contribute time and money for the good of the community. Time and again he left his work to lend his presence to the opening of a convention in San Francisco or elsewhere, or to sit in councils held for the betterment of his home town. On one occasion he traveled with a party of men to British Columbia to promote the Panama-Pacific International Exposition which was to be held in San Francisco in 1915. He doubtless felt doubly repaid for this trip as he was signally honored at every stop. In Victoria he just about stole the show. He was accorded great honors, "the Canadian Minister of Agriculture came all the way from Ottawa to greet him."[19]

He presented the schools of Santa Rosa with phonographs and moving picture projectors saying, "The emotions should be cultivated as well as the intellect."[20] He also donated $5,000 in cash for the development of a park that had been given to the city by his fellow-townsman, FRANK DOYLE, for a children's playground.[21]

I think that BURBANK's lifetime secret — the only skeleton in his family closet — was the same that troubles so many self-made men, namely, that he felt he was inadequate, had somehow missed something because of his lack of formal education. While one part of his brain hinted at inferiority, another part both denied the thought and at the same time urged that it be suppressed. But a haunting thought is difficult to subdue. He wanted to believe all of the nice things said about him — much of it cheap flattery — but in passing judgment upon himself his native honesty and common sense decreed that he apply the measuring stick he so often advised when evaluating his novelties, "look to their

[19] Santa Rosa Press-Democrat, September 3, 1912.

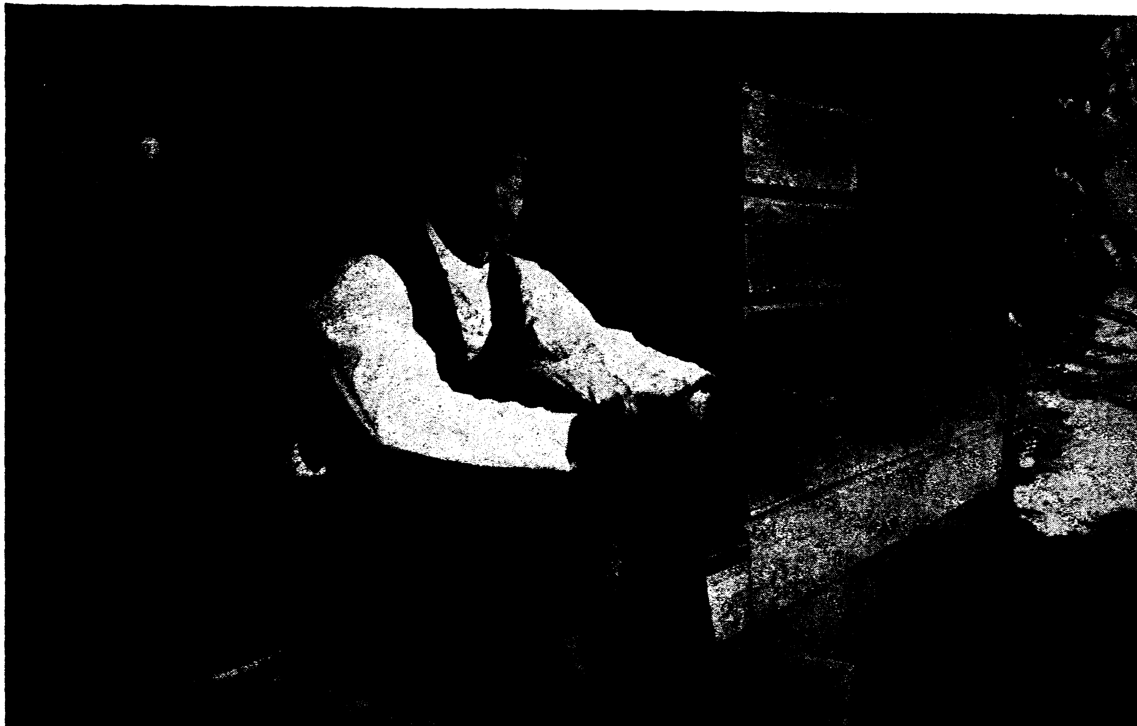
[20] Santa Rosa Press-Democrat, February 27, 1913.

[21] In a personal interview with the author, Mr. DOYLE said: "Three days after the local papers announced that I had deeded a tract of land to the city for a public park, primarily as a playground for children, BURBANK walked into my office and asked if the published statements were true, and when I told him they were, he wanted to know if it was not also true that the land, although covered with wide-spreading oaks, needed extensive improvements before it could be used as a playground and that the city had no money that could be used for that purpose. Upon admitting the correctness of his surmises, he remarked, 'I thought so' and without another word handed me his personal check for $5,000 and requested that I see to it that the land was put in proper shape."

It is highly probable that BURBANK had a sentimental interest in the tract aside from his desire to see the needs of the children taken care of, as there is an old story to the effect that when a young man, and new to Santa Rosa and to California, he did not attend church because he thought his clothes were too shabby, but instead, spent many a Sunday communing with Nature under the trees of what is now Doyle Park. It was fitting, too, that memorial services were held there following his death in 1926.

THOMAS A. EDISON, LUTHER BURBANK and HENRY FORD. — EDISON and FORD visited BURBANK during the San Francisco Exposition in 1915. This picture appears on the back cover of BURBANK's catalogue, "Twentieth Century Fruits, 1916-1917."

(*Courtesy of* Stark Brothers Nurseries and Orchards Company.)



LUTHER BURBANK at the work house on his experimental grounds (Sebastopol or Gold Ridge Farm), near Sebastopol, California, about seven miles from Santa Rosa. — PHOTOGRAPH made by Professor L. H. BAILEY in 1901 when BURBANK was fifty-two years old. BURBANK said it made him look like a Cheshire cat. (*Courtesy of* Dr. J. ELIOT COIT.)

source." (If they originated with BURBANK, they were genuine and worthy; if not, beware!) He knew that much of the fulsome praise with which he was deluged was hollow because those who dispensed it were incompetent to pass judgment — that is, ignorant of the subject — or had special reasons for their exuberant boosting.

His position, then, was something like that of one of the ancient martyrs in reverse, if the simile is not too fantastic. When the martyr felt that he was possessed of a devil (temptation, perhaps), he exorcised the demon by prayer, penance or flagellation. But BURBANK was beset with kindly furies and one does not punish the flesh on account of pleasant thoughts, if they are not sinful. So he followed the easy way, by doing nothing.

The conflict of emotions must have continued throughout most of his life — wanting to believe something but not quite daring. He knew he was a good working scientist but he also knew that he was illy-equipped to qualify as a conventional scientist. Finally, BURBANK's was not the complex character that some have supposed. On the contrary he was rather simple — simple and honest — even naïve. He applied himself to his task with a devotion and a single-mindedness of purpose that only the zealot can attain. His task was his religion, for he believed that he had a mission to perform and that one life-span was not enough time for its fulfillment. He must concentrate and he must hurry. This was why he was so impatient at interruption. There was no time to think up schemes for defrauding his fellow-man, even if inclined that way — which he was not. Being devoid of evil himself, he did not suspect evil in others when approached with grandiose schemes. He was forced to market his productions and when he set his mind to it could be a shrewd bargainer, but he never liked merchandizing. Hence he fell a ready victim when approached by promoters who offered to take over the marketing of his entire output of productions at what seemed to be remunerative figures.

One time, after tying himself up, he arbitrarily broke the bonds and was magnanimously released from his contract when it was still too early to know whether the plan was either workable or profitable. The next time, he was not so fortunate. The monetary rewards offered seemed greater and the terms less onerous than before and he went through with it to his everlasting regret because in the end he not only suffered money losses but much personal humiliation as well.

He thought they (the people he sold to) could and would pay him as they could make a good thing out of the products he was selling them, for he had plenty of confidence in these products. How they were to reap these profits was no concern of his. No doubt he assumed they would multiply the plants, seeds, etc. as rapidly as possible and then put on a selling campaign, with all the advertising artistry he had become accustomed to seeing employed by firms that had purchased individual fruits, etc. from

him in the past — especially during the last ten years since he had issued his famous catalog of *New Creations* in 1893. However, his knowledge of the nursery business must have made him aware of the fact that no considerable legitimate profits could derive to the company in the immediate future as it would require at least two years to multiply the seeds and plants in sufficient quantities to fill the thousands of orders that would come in as a result of the extensive advertising that would surely be employed.

Whether he experienced qualms or not we do not know. According to the ethics of trade he had no reason for being nervous or distraught except possibly as the debtor might naturally worry a bit as to whether the creditor could meet his obligations. Also, business morals did not prescribe that he should concern himself with the doings of his creditors as long as they dealt in lawful commodities, legally acquired; and the stock he sold the company easily met these requirements. After all, the promoters were reputedly persons of ample means, financially able to fulfill the obligations they had entered into; and I am inclined to believe that he accepted them at their own estimate without inquiring too carefully into their representations. Another evidence of this naïveté. (See Chapter VIII).

Yes, fundamentally he was artless, not difficult to understand. He wished to be fair in his bargainings, according to his lights, and not only expected but believed that others would be likewise. I do not think he should be condemned for overpraising his wares when this was the accepted practice among his contemporaries and still is, and — while the practice may be personally distasteful to some — such people continue to be rated as respectable and everywhere accepted in good society. Even dissenters should not concentrate all their opprobrium on a single individual just because he happens to be famous and therefore conspicuous. His personal morals were of the best and his business ethics would stand comparisons with many, if not most, of his competitors.

# IV

## BURBANK THE NURSERYMAN

LUTHER BURBANK was a born nurseryman if ever there was one. By this is meant that his every instinct, his every reaction, was that of a nurseryman or seedsman, for the two vocations are much alike, and he practiced both. Throughout his career, his ideals and ethics, as well as his showmanship, were ever such as we might associate with a progressive nurseryman. He loved to grow seeds and plants and to propagate and improve them and, finally, to sell them at a profit. From the very beginning of his business life he liked to show his experienced competitors that he could beat them at their own game.

The uninitiated can have little idea how difficult this would be, for the nursery and seed trades are highly competitive; and while many engage in them at one time or another, few remain in business on a national scale. It requires skill in propagation but still greater skill and acumen in determining what to propagate. Both seeds and plants are living things that must be handled with care throughout their growing period and in storage. To be sure, the bulk of the business will consist of staple items (standard varieties), but one year with another these may show little profit. Happy is the nurseryman or seedsman who can make a safe living handling only standard varieties. Yes, you have guessed it — the real profits come from promoting new things and persuading the public to buy them. Good judgment and a certain amount of boldness are necessary in making the selections and great shrewdness needed in merchandising them.

Naturally, it is the aim of every firm to offer something new each year. It is customary to issue a catalog in the autumn announcing the stock that will be ready for delivery the following spring. New varieties are described in extravagant terms. The ethics of the profession permit of this, and therein lies both the strength and the weakness of the nursery and seed business. Where such wide latitude is exercised in making announcements the unscrupulous may grossly misrepresent their offerings, and the more or less innocent purchaser has little protection or recourse as both seeds and plants are sold with broad disclaimers as to trueness to variety and other attributes. But this is not the only hazard to the purchaser. What is even more important, in the case of fruit trees, is that they be fruitful and adapted to the climate where they are to be grown. This is a vital matter to those who plant commercial orchards as it requires from four to six years for them to come into bearing, and only then can it be

known whether the variety is as represented and whether it will bloom so early as to be caught by late spring frosts. The old or standard varieties in existence are with us because they have survived long years of natural and artificial selection, nature having eliminated some of the undesirables and man the rest.

A mistake in planting annual crops such as vegetables, flowers, and grains is not so serious because soon discovered and only one season is lost. Fortunately, the farmer, fruit grower, gardener, or florist who plants on a large scale or deals with expensive crops and equipment is usually an experienced person who appreciates the risk of depending on new and untried things. He must, however, be alert enough to keep up with the times for new and better varieties do occasionally appear. So he must take what is offered, plant in a small experimental way, and observe their behavior. For the most part, he must be conservative and stick to those things which have been thoroughly tested. On the other hand, the amateur who has only a home garden is apt to be attracted by the glowing descriptions and plant the new things exclusively, often to his regret. While the individual suffers little monetary loss even at the high prices paid for novelties, such orders in the aggregate represent enormous sums that we pay annually as a tribute to our enthusiasms and gullibility. Those that plant in a spirit of adventure or as experimentalists no doubt secure their money's worth, but others would do better to stick to tried and proven things.

BURBANK was both shrewd and resourceful. As a boy in Massachusetts he found that he could not successfully compete with established market gardeners in the selling of vegetables unless he could offer a product that was superior in some respect; so he began to hybridize varieties with the idea of producing something that would mature earlier than normal, and actually achieved some success in this directon by offering a type of sweet corn that was a week earlier than usual.

Transferring his activities to California, he drifted by easy stages into the nursery business. At first he worked for a few months for a nurseryman in Petaluma, and about 1877 started a nursery business of his own on his mother's place in Santa Rosa. He entered the nursery business at a time when eastern markets were beckoning to California for its fruits. The transcontinental

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TEXTFIGURE 3.—COVER OF A LEAFLET, issued by BURBANK in 1892, just previous to the announcement of several of his spectacular fruit hybrids, and he was becoming concerned about his ability to market his productions and still find time to continue with his experimental work. Nothing came of his offer to become a member of a stock company, either because he was not yet famous enough to attract speculators, or, more probably, because he found that he could sell most of his productions outright himself, and thereby retain full control of his business. His temperament was such that he could brook no interference with his affairs by anyone and he thought he had his problem solved by selling each new production "lock, stock, and barrel," for cash, as produced. Twenty years later this policy led to his financial downfall, and indirectly, to heartbreaking losses on the part of many of his trusting friends.

# The Time is Now at Hand

WHEN Eastern planters are beginning to realize that all the valuable novelties do not originate in Europe or Eastern America, and those who have not yet grasped that fact may not know that for many years Eastern seedmen, florists and nurserymen have been selling as novelties, trees, plants and seeds which originated on my own Experimental Grounds at Santa Rosa.

These novelties must first be sold in Europe and distributed from there in order to receive sanction and sale in America.

## THE TWENTY MILLION

Hybrid and cross-bred seedling plants which I have produced during the past twenty-five years, and the twenty-five thousand dollars, and the endless labor bestowed in hybridizing, selecting, testing, etc., is now being more generally recognized, and some of the fruits and flowers originated by my labors are becoming household words wherever fruits and flowers are admired.

In the fall of 1893 two new Quinces will be introduced: The "Van Deman" and the "Santa Rosa." They are in all respects the greatest advance ever made in improving this fruit. These new varieties are of the most beautiful form, smooth as an apple, rich golden color, and without a trace of the unsightly wooly substance which so much disfigures the Quinces now known.

Van Deman is larger than any known Quince, both are unequaled in size, early bearing, productiveness, beauty of form and color, and the quality of the fruit is such that they are, when ripe, tender and good to eat uncooked like Apples, both cook as quickly as Apples and are delicious whether cooked like the old fashioned Quinces, or baked like Apples.

The six hundred thousand hybrid and cross-bred seedling Berry plants which I am growing, and more than half a million hybrid seedling Lilies are producing profound surprise and admiration, and from the vast chaos of commingled species, forms have been created and segregated which will produce great and unsuspected changes in fruit and flower culture.

When I mention, for instance, a Blackberry x Raspberry hybrid of largest size which ripens before Strawberries, before Raspberries bloom and before other Blackberries show a single leaf or bud, some idea may be formed of some of the tremendous changes which will be produced in berry culture. The *best*, after a most exhaustive and careful trial, will be introduced from time to time.

The above does not even outline the work which is being accomplished on my Experimental Grounds, only having mentioned two or three of many thousand horticultural acquisitions which only a few years ago were thought to be utterly impossible. My time is so wholly occupied in their production that I cannot well attend to their introduction and will sell the stock and complete control of some of the most promising new fruits and plants, or would be a member of a joint stock company, for their introduction.

Correspondence on the subject solicited.

**LUTHER BURBANK,**
*Santa Rosa, Cal.*

Though perhaps unnecessary, I may refer as to the extent and value of my horticultural labors to

Prof. H. E. Van Deman, U. S. Pomologist, Washington, D. C.

Prof. T. V. Munson, Dennison, Texas.

Prof. E. J. Wickson, Editor *Pacific Rural Press* and author of "California Fruits," San Francisco, Cal.

railroad had been completed only a few years before, and here and there daring spirits were shipping fruit to far-away Chicago and receiving fancy prices. Of course, little was known about refrigeration or methods of packing for long shipments, but some had successfully pioneered the venture and much interest was aroused in planting orchards and vineyards. The times were favorable for starting a nursery as existing concerns could not keep up with the demands for planting-stock. Especially was this true of prunes because that fruit could be sun-dried and sent to distant places with little danger of injury in transit. This looked like a safe crop and plantings, accordingly, were large.

In the midst of a financial depression and without capital or credit BURBANK necessarily had to start in a small way, budding, grafting, planting, and cultivating all his trees himself with his own hands. Under ordinary practice two seasons are required for producing a young fruit tree ready for orchard planting. The seeds are planted in the spring for the first season, and in late summer of the same season the little seedlings are budded near the ground to the desired variety. The buds unite with their host but remain dormant. The following spring — this is the second season — the trees are cut off just above the transplanted buds and all subsequent growth, consequently, directed into them, and by October, in California, they make trees four to six feet tall. When the leaves fall, they are ready to be dug up and planted in the orchard.

Sometimes excess seedlings are sold to people who want to do their own budding. Although the small nurseryman may be specializing in the production of fruit trees he usually helps out his income by propagating a few grapevines and ornamental shrubs from seeds or cuttings, as all of these reach salable sizes in a single season. BURBANK must have done something of this kind for he tells us[23] that he had an income from his business the first year, 1877, of $15.20. Next year when the first budded trees became marketable, his income rose to $84. The third year, 1879, the sales were $353.28, and the fourth year they mounted to $702. He says: "... it was not until 1881 when the nursery had been for five years in operation that the aggregate returns from the sale of its products of all description passed the one thousand dollar mark. The exact figure was $1,112.69."

Then he did a spectacular thing that was truly Burbankian in its shrewdness of conception and boldness of execution. He accepted an order for 20,000 prune trees to be delivered inside of 12 months, and made good to the extent of actually delivering 19,500 trees greatly to the delight of the customer and to the enhancement of his own reputation. This was the first time that he was referred to as a "plant wizard". Although this was a horticultural stunt that had been employed by others, BURBANK de-

[23] LUTHER BURBANK, his methods and discoveries and their practical application. Edited by HENRY SMITH WILLIAMS. The Luther Burbank Press, Santa Rosa, California, 12:82, 1915.

serves full credit for having had the enterprise and initiative to do something that was new to his locality if not to the state. In the southern states the process is known as June budding or force budding, and is widely used in the propagation of peaches. Mr. JOHN FRAZER,[23] a veteran nurseryman of Huntsville, Alabama, thinks the practice originated in what is commonly known as the Huntsville area which includes Northern Alabama, Northern Georgia, and Central Tennessee. He doubtless refers to the commercial use of the practice, as the method must have been known by propagators in warm countries wherever peaches are grown as far back as varieties have been perpetuated by means of budding.

Successful June budding depends upon a long, favorable growing season. The buds must be inserted when the trees are still very small — in fact, as early as it is possible to obtain buds from the current season's growth on bearing trees. When the bud is established beneath the bark of its host, the top of the little tree is partially broken but not detached. This forces the growth into the bud, and, when it begins to push, the top is wholly removed. During the remainder of the season rains must be frequent to make trees of marketable size. In California growth is regulated by irrigation.

There is prejudice against June-budded trees in some sections of the country, and this feeling is kept alive by those who, for climatic reasons, are unable to grow such trees. As a matter of fact, trees that are grown in a single season are equally as good as those grown in two seasons if they are of the same size, but the cost of producing them is less. If the nurseryman who does grow them passes along this saving to the consumer it is easy to see why his northern competitor may exhibit jealousy.

In California, BURBANK was "made" as a nurseryman as a result of his prune tree exploit. He received a vast amount of favorable publicity, even beyond his home state — the kind of publicity that money will not buy. In this respect he emulated his friend HENRY FORD, whom he greatly admired. Like FORD, he was always about two jumps ahead of his competitors. And he was ever thus.

The nursery business thrived and in 1883 he purchased four acres of land across the street from his mother's place. This was then in the center of the town of Santa Rosa. He was now definitely established in his chosen line and began to branch out into the specialized field of plant improvement that he had always had in mind. Of this period he writes:[24]

"At about this time there was an interest in the native plants of California, and many nurserymen were anxious to give them a trial. During those years when my own nursery business was only formative I eked out an income — in intervals of carpenter

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[23] Personal letter to the author, July 27, 1939.

[24] LUTHER BURBANK, his methods and discoveries and their practical application. Edited by HENRY SMITH WILLIAMS, 12:99, 1915.

work — by gathering seeds and bulbs on orders from various eastern and foreign firms. In the course of this work I made various trips to the surrounding territory. On two occasions, in 1880 and 1881, I visited the region of the geysers, which was found to be a productive locality for new material. And everywhere I went careful study was made of the vegetation, both with an eye to the immediate collection of seeds and bulbs, and for future reference in connection with the projected work.

"Even before I could see my way to the abandonment of the practical work of the nurseryman, projects were in hand that were preparing the way for the new activities. In particular, I had sent to Japan to secure seeds and cuttings of a great variety of fruits. It seemed certain that I could better afford to hire collectors in foreign lands to secure material than to go to foreign lands in person in quest of it.

"The first consignment of Japanese seeds and seedlings reached me November 5, 1884. In preparation for their coming I had purchased the Dimmick place and prepared my experiment grounds a few months earlier. And when the consignment was in hand, with the representatives of exotic species of fruits, I felt that a new era had begun for me, and that the long frustrated plans were about to find realization.

"The following year, so well had the nursery business prospered, I was able to purchase a farm at Sebastopol, seven miles away from Santa Rosa, where the conditions were more favorable for the growing of some types of plants.

"The second consignment from Japan, including the plum, whose story has elsewhere been told in detail, came December 20, 1885. The place at Sebastopol where they were to be planted and nurtured was purchased eight days later. And with this purchase the project of devoting a lifetime to the work of plant experimentation was fairly and finally inaugurated. For the Sebastopol place, with its eighteen acres, was not purchased for use as a practical nursery, but solely as an experiment garden.

"With the development of the Sebastopol place, a new phase of life work began.

"Thenceforward my time was divided between the experiment garden at Santa Rosa and that at Sebastopol, and upon one place or the other all my experiments in plant development were to be performed.

"An interest in the nursery business was retained for two or three years more, to give money to carry out the initial stages of the new experiments; for of course it could not be expected that new varieties of fruits and flowers would spring into existence in a single season. Nor could instant purchasers be found for them if they had been thus magically produced. But from the time when the place at Sebastopol was purchased, the die was cast, and it was determined in future my energies were to be devoted to the work of plant development — the work that had been

projected, and at which a beginning had been made back in Massachusetts, and hope of continuing which had been the incentive to persistent efforts during the period of stress and privation."

The year 1887 marked the appearance of BURBANK's first real nursery catalog — a 24-page brochure[25] offering the usual standard varieties of fruits, but in addition, many new things including the initial announcement of the first of the long line of Japanese plums he was later to introduce, such as the Blood Plum of Satsuma, which he received from Mr. ISAAC BUNTING, an export-import agent in Yokohama, Japan, December 20, 1885. An eight-page supplement[26] followed very shortly the same year. The contents of the catalog showed that he was going in heavily for new things — novelties he called them — and although he did not claim to be the originator of these unusual things, he left that impression, a trick that was not unusual among nurserymen. Several promising seedlings were listed; among these were apples, pears, plums, peaches, figs, persimmons, olives, and oranges. He refers to himself, about this time, as a dealer in novelties. But while most nurserymen were content to let others find new and promising things as chance seedlings, he was importing from Japan things that for the most part were entirely new.

As I peruse the catalog which lies before me, I am amazed at the modest manner in which he announces the new Japanese plums: the Botan, Chabot, Long Fruit, Masu or Large Fruit, Botankio, Botankio No. 2, and especially the Blood Plum of Satsuma, all of which he knew to be brand-new. This was not like him. He had not yet learned to make the fullest use of the printed word. It is true that he did expand slightly in describing the Blood Plum of Satsuma by stating that he had the only tree growing in America and that it had cost him $40 in Japan, but the statement was made in 8-point type! The price quoted was one dollar per tree or seventy-five cents each for dormant buds. The only explanation I can offer is that he did not realize what he had. This mistake was remedied to some extent in the supplement that followed the catalog, but even here his walnuts and chestnuts from Japan were given more publicity space than the plums. As it turned out, the walnuts are merely a curiosity and the chestnut only of minor importance, while the plums laid the foundation of a huge industry, particularly in California and South Africa, and are of considerable importance in many other states and countries.

Because the introduction of the Japanese plums was a distinct achievement and because some doubt has been expressed by

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[25] Catalog of fruit and shade trees, ornamental plants and roses, grown and for sale at Santa Rosa Nurseries, LUTHER BURBANK, Proprietor, Santa Rosa, Sonoma County, California.

[26] Special descriptive circular of some new rare and very desirable trees and plants grown for sale by LUTHER BURBANK, Santa Rosa, Sonoma County, California.

LEONARD COATES[21] as to whether BURBANK actually brought them in or obtained them from a San Francisco importer, it will be of interest to cite a bit of background. In the first place, even if COATES did have some basis for his claim, I should not take him too seriously, for they were professional rivals and business competitors. COATES had the reputation of being a man of high and honorable principles but in this case he seems to have been obsessed by envy or jealousy.

Another reason why I believe that BURBANK really imported the Blood Plum of Satsuma was a statement that he makes, which I think is genuine. In one of his catalogs he tells about an occasion, presumably in the early eighties, of browsing in the Mechanics Library in San Francisco when he came upon a book of travels in which an American sailor told of having visited the province of Satsuma in Japan and there saw and ate plums with a deep red flesh. This excited BURBANK's imagination, and he determined to secure some of the trees at the first opportunity. The first shipment he received from his agent in Japan, as stated before, arrived in 1884, but the trees had dried up and died in transit. He immediately re-ordered and the second shipment arrived December 20, 1885. Among BURBANK's effects after his death, I found a memorandum partly in his own handwriting and partly in typewritten form as he tapped it out on his ancient typewriter, a manner of writing that I am very familiar with from having seen many of his letters of the period. This memorandum had apparently been made out at different times for his own information. It began in 1875 and ended in 1910. Under the entry for December 20, 1885, the statement reads:

"New Japanese plums imported (from ISAAC BUNTING, Yokohama)

No. 1 —Blood Plum of Satsuma.
No. 2 —Large red plum, very good. [Later named Burbank.]
No. 3 —[Plum]—green skin, conical shaped, red flesh.

[21]Personal interview with LEONARD COATES, veteran California nurseryman, in the summer of 1932 just before his death. COATES was something of a plant hybridizer himself having originated and introduced a prune, the Coates 1418, that was widely planted in the early twenties but afterwards declined in popularity. COATES stated that J. E. AMOORE, a tea buyer in Japan, came to San Francisco in the eighties and set up a Japanese tree-importing company and thousands of plums were brought in under Japanese names, and he thought it was highly probable the Satsuma was thus introduced. There was some ground for COATES' supposition, for BURBANK did procure some trees from an importer—how many, we do not know—as shown by the following statement by BURBANK, copied from "LUTHER BURBANK, his methods and discoveries and their practical application", Vol. 5, page 36.

"The Satsuma and Burbank were the only two among my 12 seedlings that were directly introduced, although sundry of the others subsequently had a share in the production of hybrid races. It should be recalled also that I had somewhat earlier introduced three plums of Oriental origin—the Abundance, Chabot, and Berkmans, that were also a direct product of Oriental stock grown and fruited by me *from seedlings purchased from other importers.* [Italics mine.] I have not dwelt at length on them here because they seem of relatively less importance in retrospect than they appeared at the time when they were introduced."

No. 4 —Prunus Japonica, large, conical, red, good.
No. 5 —Supposed Korean variety.
No. 6 —Prunus Japonica—preserving variety.
No. 7 —Large white [plum]—Like Washington.
No. 8 —Prunus Japonica—pale yellow or white.
No. 9 —Rose colored, flowered variety, Prunus mume — small.
No. 10—Earliest preserving variety.
No. 11—Prunus mume.
No. 12—Very late bearing variety [plum?]."

The descriptions mentioned were evidently supplied by Mr. BUNTING, the exporter.

The memorandum states that there were 100 specimens of Blood Plum of Satsuma in the shipment and 10 trees of each of the others. This does not square with a statement attributed to BURBANK in Volume 5 of the book *Luther Burbank, His Methods and Discoveries*, etc. in which he is made to say, after recounting the failure of the first shipment to arrive in good shape:

"A little over a year later on December 20, 1885, there arrived the 12 seedlings to which I have already referred. And this time, to my great satisfaction, the tiny trees were found in good condition."

This discrepancy is one of detail rather than one of merit. Just how many trees of a variety were in the shipment is of no great importance. I believe the BURBANK memorandum I referred to is genuine but statements made in his 12-volume book must be accepted with discrimination. Some of them were undoubtedly made by BURBANK while others, obviously, were not.

I have stated that the editor, HENRY SMITH WILLIAMS, was a highly experienced compiler of semi-scientific books. He had a long list of encyclopedias and other literature intended to popularize science to his credit. He apparently cared little for exactness, which makes it difficult to secure definite information from his set of BURBANK books. It is a pity that when he had the chance to obtain facts, figures, and dates from BURBANK as far as it will ever be possible to secure them, he did not make use of the opportunity. BURBANK himself kept scant records so that dates might have been difficult to obtain, but I have no evidence that the editors valued such information or tried to obtain it. Apparently the task that had been given to HENRY SMITH WILLIAMS, as chief editor for the Luther Burbank Society or the Luther Burbank Press, was to write a readable book that would sell and, whether so instructed or not, he evidently conceived it to be his job to glorify BURBANK and make a great hero of him. (See Chapter VIII.)

By 1888 BURBANK's nursery was netting him something like $10,000 a year, but he was so determined to embark upon a career of improving plants that in that year he sold a part of it to his partner, R. W. BELL. The latter assumed the propagation and sale of standard varieties of nursery stock while BURBANK, of course, retained control of all of his novelties. In 1889 he in-

troduced his Burbank plum and ten new varieties of gladioli. From then on he turned out new things every year, but he did not consider that he had thoroughly arrived until 1893 when he issued his famous 52-page catalog, *New Creations in Fruits and Flowers.* He was already known throughout the United States, but this publication carried his fame to foreign lands.

BURBANK early adopted the plan of bringing a new fruit or flower to fruition, and then selling the entire stock to a purchaser for a lump sum in cash. He did not have the facilities for propagating and retailing very many of his originations and apparently did not want the responsibility of handling them. His chief customers, therefore, came to be the established nurseries and seed firms of the country. J. C. VAUGHAN, HENRY A. DREER, JOHN LEWIS CHILDS, STARK BROTHERS, and W. ATLEE BURPEE became his customers.

Beginning in 1893, according to his records, J. L. CHILDS entered the picture and became one of the largest purchasers of his wares. A great many of the new things were sold without names, or the purchaser had the privilege of renaming them. It was CHILDS who sold the so-called Wonderberry about which extravagant claims were made and which caused a controversy that did not subside for years, and echoes of which were still faintly reverberating at the time of BURBANK's death in 1926. This controversy was the outgrowth of the action of the judges of the Boston Flower Show, July 17, 1909, in declaring the BURBANK Wonderberry to be worthless. The *Boston Post* the next day said, "LUTHER BURBANK received the first severe snubbing yesterday when his latest creation, the Wonderberry, or Sunberry, was declared a failure. . . . The Sunberry is a hybrid produced by crossing the *Solanum nigrum* with the *Solanum africanum,* both of which are related to the potato and tomato . . . . was expected to prove a rival to the Blueberry." This plant was originally named Sunberry by BURBANK but was renamed the Wonderberry by CHILDS who published a collection of recipes entitled "100 Ways of Using the Fruit of the Sunberry or Improved Wonderberry." *The Rural New Yorker,* a crusading agricultural paper, pounced upon BURBANK and accused him personally of making false claims about his introduction. As a matter of fact, most of the claims were made by CHILDS, but it was never the policy of BURBANK to disavow laudatory statements made about himself or about his products. Also, it appears to have been a lifelong policy of his never to admit that any one of his products was a failure.

The earliest foreign nursery customer I have any record of was H. E. V. PICKSTONE of South Africa, who began buying Japanese plums in 1898 or earlier and continued to be a customer as long as BURBANK lived. JOHN M. RUTLAND of Australia was a customer for only a short time but a very profitable one. He started in by buying the Santa Rosa plum and the first plumcot which was named the Rutland. This was in 1905. Next year Mr. RUTLAND bought a long list of plums for which he paid over $6,000.

Later RUTLAND plunged on spineless cactus for which he paid thousands of dollars for the exclusive right to sell that succulent in the Southern Hemisphere. I have plenty of evidence to convince me that BURBANK actually bred most of the varieties of cactus that he sold. I have interviewed people who worked for him at the time, had a hand in the actual work of hybridizing, and I also have the evidence of Professor DE VRIES, the Dutch botanist, who visited BURBANK while the cactus breeding program was in progress. I wish to say here I am convinced that BURBANK fully believed in the worth of his cactus when he first promoted it. Later, he should have known better.

BURBANK was a strange combination of the naïve and the sophisticate — the latter word being used in the sense that he was far-sighted and a shrewd bargainer. But his far-sightedness sometimes took on the substance of dreams when he could make himself believe what he wanted to believe. He was so proud of the fact that he could do the impossible in the way of modifying plants — that is, what most people thought to be impossible — he was fond of saying that we can go to any limits that we wish in that direction.

Having lived a good part of his life in an arid country, his common sense should have told him certain things about what the cactus might be expected to do, but by the time he began dealing with this plant he had gotten into a state of mind where he could believe his own sophistries. He could have obtained first-class advice from people who lived in the semidesert country of Texas, New Mexico, and Arizona, but he was bulletproof against advice or even suggestions unless they happened to coincide with his own views. Perhaps this is not so strange when we think of the representative of the Australian government who came to California to make a special study of the possibilities of the spineless cactus with a view to introducing it into Australia for planting widely in some of their vast regions where rainfall is insufficient to produce grass. This man interviewed stockmen in Texas, a botanist at the Arizona Agricultural Experiment Station, and many others including BURBANK, and finally went home and made a voluminous report that the cactus seemed to be all that was claimed for it.

About this time swarms of letters began to be received at the Agricultural Colleges and Experiment Stations and at the United States Department of Agriculture, Washington, District of Columbia, inquiring whether the claims about BURBANK's products were true. Since the major portion of these claims were being made by nurserymen who bought things from BURBANK and who had gone BURBANK one or even several better in their extravagant statements about this and that, the authorities naturally had to say that most of the reports would have to be discounted from fifty to one hundred per cent.

Spineless cactus was one of the bones of contention between BURBANK and his friends and officialdom in Washington and in the states. Friends of BURBANK, making use of the criticism

levelled at him by government officials, sought to make capital out of the situation by having Mr. E. A. Hayes,[28] a California representative in Congress, introduce a bill authorizing the United States Department of the Interior to set apart twelve sections of semidesert or desert land (7,680 acres) in one of the semiarid states to be turned over to BURBANK for further experiments with cactus. This bill[29] was actually passed by the House of Representatives but failed of approval in the Senate.

In 1909 BURBANK agreed to sell the right to merchandize all of his products and a company was organized for the purpose, but at the last minute he reneged on the contract before the business could get under way.

It was stated elsewhere that there is sharp competition between firms dealing in seeds and plants and that their very lifeblood is the new things they can offer, so it is not surprising that many florists now began to complain about BURBANK and his products being over-publicized; but as far as I can see he did not do a thing that they themselves would not have done if they had had the opportunity. In their ranks were many persons who had originated new varieties of flowering ornamentals and each one, of course, was proud of his plant "baby". For BURBANK to come along and advertise scores of new varieties was too much for them to bear in silence, so the explosion came. The following account is culled from the columns of the *Pacific Rural Press* of San Francisco, under date of August 14, 1909:

"The most sensational agricultural event of the week is the arraignment of Mr. LUTHER BURBANK at the bar of horticultural judgment. We have apprehended its coming for a long time. We have not hesitated to state in these columns that the extravagant exaltation of the man and his achievements by those who really did not know either one or the other was, in our view, the most serious menace to his career, because it caused him to be misjudged and his work to be misunderstood. *The logical reaction from fulsome adulation is denunciation* and this is the phase which Burbankian development has now reached. It had to come; it is better now than later:

" 'Be it resolved, the Pasadena Gardners' Association hereby strongly condemns the nature-faking methods and exploitations of alleged but false creations by LUTHER BURBANK, and deplores the fact that a false impression has been given the public concerning plant breeding by BURBANK; it is the sense of this association that this impression should be corrected.'

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[28] The Press-Democrat, Santa Rosa, California, March 2, 1912. Representative HAYES of California delivered a speech in Congress asserting "That in the Department of Agriculture there has lately been manifested a desire to belittle this great man and his work and to hold him up to ridicule." HAYES explained the magnitude and value of his achievements. . . . "99% of the plums shipped out of California," he said, "are of the varieties originated by BURBANK and practically all the potatoes." Congressman HAYES was not specifically endorsing the value of spineless cactus so much as he was defending BURBANK'S reputation for attainment.

[29] H. R. 23043, 1912.

"This indictment is said to have been unanimously voted last week by about a hundred people duly assembled at a meeting of the society named in the resolution. It is, in work and spirit, fairly representative of the attitude which a considerable number of professional gardeners and commercial florists hold toward Mr. BURBANK's work. His plants do not enter to any extent into their stock, which is chiefly comprised of varieties originated by specialists working in their special lines and to whom they extend loyal deference. Naturally, these stars shine bright and large in this narrow horizon and no one denies them right to the homage of their worshippers. Mr. BURBANK has worked in these branches and demonstrated wonderful achievement. He blazed the way which some of these florists' specialists have followed and have won distinction in the eyes of their peculiar constituency. All would have gone well if the envy and ill will of this contingent had not been excited by the extravagant, distorted and untrue accounts of Mr. BURBANK's motives, expectations and methods which have been rife in the popular press. Men, who seem to them great, have been ignored. BURBANK, whose 'stuff is no good', as they wrongly but honestly claim from their point of view, has been almost deified. They become indignant, they lose capacity for calm and cool judgment, they cry aloud.

"As we have said, we have apprehended just this situation and have feared it, not from any permanent effect upon Mr. BURBANK's fame, but because of the embarrassment and ill feeling and the utter waste of effort required to overcome it. Mr. BURBANK feels the weight of this trouble. In an interview since the Pasadena proclamation, he is credited with saying:[30]

"The extravagant estimates of my work have been the bane of my existence. There has been much written about me by sensational writers who know nothing either of me or my work. I am not responsible for all these things and anyone with any knowledge of horticulture could discern at once that much of the stuff sent out is nothing but the space-writer's chaff."

BURBANK had been so much publicized and was now so widely known that he had many offers to sell out or take someone into partnership. However, he was still a one-man institution. Finally in the spring of 1912, for the second time, he contracted to sell all his past, present, and future creations involving what was termed "one of the biggest deals of its kind in the world."[31]

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[30] San Francisco Chronicle, August 10, 1909.

[31] Santa Rosa Press-Democrat, Santa Rosa, California, November 2, 1912.

"The formal transfer of the commercial side of LUTHER BURBANK's business to the new corporation which is henceforth to handle the BURBANK seed and plant creations exclusively, was made on Thursday, ROLLO J. HOUGH and W. GARNER SMITH representing the purchasers." Mr. HOUGH said, "The final steps have been made in taking over the commercial end of LUTHER BURBANK's business. In fulfillment of the conditions of the sale effected last April, Mr. BURBANK turned over his business Thursday and from now on will devote his whole energies to his creative work.

"It is our purpose to push the seed and nursery end aggressively for we

The Luther Burbank Company lasted but little over three years when it was thrown into bankruptcy as a result of a suit filed by BURBANK to recover money said to be due him on a promissory note.[33] His attorney declared that he had been the victim of "stock pirates", and that other suits would be filed.

BURBANK claimed he would have brought suit much earlier than he did had he not harbored a forlorn hope that the company might pull through. He attributed the failure of the business to mismanagement. As a matter of fact, the company undertook the impossible when it began advertising practically everything that BURBANK had ever put out and apparently in unlimited quantities. It has been explained before that BURBANK never kept much of a stock of any of his products on hand, it being his habit to sell out completely of each item as soon as it was ready for marketing. If there were a few pounds of seeds and a few trees each of several varieties of fruits on hand, it would require at least three seasons to multiply them in sufficient quantities to fill orders on a national scale.

There were charges and countercharges, but the facts appear to be that the company officials, being entirely unacquainted with horticultural plants and the hazards that attend the planting of new and untested things, especially hybrids, confidently accepted BURBANK's enthusiastic descriptions and claims as to their value; and the inevitable happened, namely, that a high percentage of them did not make good. As many of the seeds were annuals, it required only one season for the customer to detect the misrepresentation, and further sales became increasingly difficult. This was a contributing factor in making it impossible for the company to meet its monetary obligations to BURBANK and stockholders.

As a matter of fact, the Company, in many respects, was but the lengthened shadow of BURBANK himself, as it accepted everything he said about his plants as facts and advertised them accordingly. BURBANK must have known that the Company was conducting a precarious business, inexperienced as the management was in the merchandizing of seeds and plants, but I can find no

are confident that it is possible to build up a business that will rank with the largest of its kind in the United States.

"It is likely that Santa Rosa will be made the distributing center and that seed farms and nurseries will be established in this vicinity, but with the exception of the Broadmoor Seed Farm near Oakland, no definite action has been taken in this regard. The business of the Company thus far has been conducted from our San Francisco offices.

"The corporation has ample resources to accomplish its purposes, up to $500,000, and is composed of a number of prominent bankers and business men of San Francisco, Oakland, and Santa Rosa, a certain portion of stock in the corporation having been allotted to those friends of Mr. BURBANK in Santa Rosa who desired to be identified with the new company.

"All the desks and typewriters were taken from BURBANK's home yesterday, together with his correspondence files and his account books. No longer will he need the services of a secretary and bookkeeper. He can give all his working hours to the labor of his life, and undoubtedly the result will be a new pace of achievement, a greater number of wonders to astonish the world. Henceforth, LUTHER BURBANK will have nothing to sell to anybody. . . ."

[33] Santa Rosa Press-Democrat, Santa Rosa, California, December 31, 1915.

evidence that he ever tried to do anything about it; and certainly he was always willing to continue selling to them as long as they would buy. In principle, this was in accordance with his usual practice, but the difference in this case was that whereas formerly he had sold one or only a few articles at a time — and always for cash — he now was obligating himself to sell everything he had or ever would produce, and accepting notes — for the most part — from the vendee, instead of cash. He evidently did not see any reason why he should concern himself with the advertising methods this or any other company might employ in selling his products— all he cared about was receiving the money that had been promised him.

It is a matter of viewpoint as to whether, under the circumstances, BURBANK was culpable. Many a business man would have done the same thing. The chief wonder is that he did not realize that his reputation was being undermined because his name was being used so recklessly. As a matter of fact, the public never has understood that all of the selling of BURBANK's products during the years 1913-1915 was entirely out of BURBANK's hands. Throughout the United States, exclusive of California, I have scarcely found one person in a hundred who ever heard that the Company was separate from BURBANK. A few had heard of the Company but thought it had been organized and was managed by BURBANK in person. It was this Company that made most of the extravagant claims for spineless cactus although BURBANK had paved the way by making some whopping big claims himself.

The Company seems to have taught BURBANK one thing: dealing in seeds was more profitable than dealing in nursery stock. After the Company had been successfully repudiated and his affairs were again in his own hands, he gradually gave up the tree business and confined his activities to the production of seeds of various kinds — flowers, vegetables, and grains — for he soon began issuing catalogs of seeds and bulbs[83] with a sprinkling of fruit catalogs in which he listed all of his more important plum introductions after they were supposed to have been sold "lock, stock, and barrel," as he once said, to various nurseries. At first the seed catalogs listed only things that BURBANK claimed to have himself originated, but later he also included a list of standard varieties. Still later, there was no way of identifying items as to whether they were new or standard.

During the last years of his life BURBANK farmed out his tree growing to another nursery which grew them under contract,[84] while he dealt in nothing but seeds and bulbs. Perhaps his advancing years made this necessary, for he was no longer physically able to perform the severe duties of looking after his collection of trees, attending to the pollination, and caring for his nursery.

[83] BURBANK's 1917 new creations in seeds, and some older ones of special value. — BURBANK's bulb catalog and how to judge novelties. — The new BURBANK wheat. — BURBANK's 1918 new standard grains.

[84] The Armstrong Nurseries, Ontario, California.

Apparently a great many of the flower and vegetable seeds listed as "new creations" were $F_1$ and $F_2$ generation hybrids of standard varieties, the crosses having been made in many instances in a wholesale manner by growing the varieties in adjacent plots and letting insects be the pollen carriers.

Having lost money in his dealings with the Luther Burbank Company,[35] it required some time to get on his feet again financially. During the early twenties and up to the time of his death he was gradually building up a very profitable business in selling seeds. After his death, there being no one to carry on the work, his widow sold the entire business to STARK Brothers of Louisiana, Missouri, under two contracts:

(1) For the name and good will of the bulb business and all of the seeds, and with the names and index cards of all customers; implements and supplies, and all catalog material; cuts, pictures, photographs, variety names, copyrights, trademarks, phrases and slogans used in the business, and

(2) For the exclusive right to all uncompleted experiments with fruits at Sebastopol for a period of ten years including those fruits mentioned in the *Final New Fruits Bulletin* which was issued in 1927, but not including the Royal and Paradox walnut trees. This contract also included the right to "certain grafts and buds sent to the Armstrong Nurseries at Ontario, California," which STARK's took over to propagate and sell on a royalty basis.

STARK's also reserved the right to renew these contracts for terms of five, ten, fifteen, twenty-five, or forty years. STARK's made some arrangement later under which they were allowed to sell the Royal and Paradox walnuts, there being one large old Royal tree at the Sebastopol orchard and a Paradox in the BURBANK garden in Santa Rosa. STARK Brothers evidently did not find the bulb and seed business profitable as they did not exercise their option to renew the contract. But in 1937 they did renew the other contract for an additional ten years.

STARK Brothers have set up at Louisiana, Missouri, what they call an experimental garden wherein are grown as many of BURBANK's products as they have been able to obtain but chiefly those things they control under their contracts with Mrs. BURBANK. They call this garden "Stark's Luther Burbank Experimental Farm."

After closely observing the collection of seedling fruit trees which BURBANK had growing in his Sebastopol Experimental garden at the time of his death, STARK's have introduced many of them as new varieties, 34 to be exact, under a new Federal regulation which permits them to be covered by plant patents taken out

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[35] Personal conversation with BURBANK in September, 1915. Referring to the Company, he said bitterly: "They swindled me out of everything I had and I shall have to start all over again." Strong words, but like sundry other statements of his, to be taken with a grain of salt. In truth it seems to have been a case of having been hoist by his own petard.

in the name of Mrs. BURBANK through an arrangement whereby she receives a royalty on every tree sold.

BURBANK did not leave much income property at the time of his death although he held title to a few tracts of good ranch land in addition to the Experimental Orchard and the two gardens in Santa Rosa. A major part of the original BURBANK home place, consisting of four or five acres, was sold off as residence lots; and when no more could be sold on account of the financial depression of the early thirties, Mrs. BURBANK deeded the remainder to the Santa Rosa Junior College, retaining only the old home site, originally owned by BURBANK's mother, the old greenhouse which BURBANK used for over thirty years, and the studio building, with just a bit of land around them.

The tract of land across the street which originally consisted of four acres, upon which is located the large brick house which BURBANK built in 1906 and lived in until the time of his death, has been partially sold for residence purposes, and the building is used by a firm under the name of "BURBANK School of Business."

# V

## BURBANK THE SCIENTIST

IT IS my opinion that BURBANK died a disappointed man because he was not accepted by the world as a scientist. Whether he was one really is a matter of terminology because he did have many of the instincts of a scientist and did much — yes, very much, both directly and indirectly — for the cause of science.[36] His greatest achievement was popularizing plant breeding by demonstrating its possibilities, and this aroused public interest was the leaven that quickened men and institutions into activities that resulted in the advancement of the science of breeding by at least twenty years. It was the ballyhoo of his misguided friends that cheapened his attainments in the eyes of scientific workers and robbed him of the place he might otherwise have occupied in the literature of his time.

Of the considerable number of men in the 18th and 19th centuries who engaged in the hybridization of economic plants with the primary purpose of securing improved types and varieties and who won a place in the scientific annals of their day, BURBANK, by his aims and ideals, might best be compared to THOMAS ANDREW KNIGHT of England. KNIGHT believed inasmuch as the pear from southern climes had been adapted to the cool climate of England and the crab apple of England in the same manner adjusted to the frozen regions of Siberia, that it would also be possible to adapt the peach and grape to the unfavorable climate of England. In addition, he believed that it was possible to produce varieties for special purposes as regards both form and quality of fruit. It was not his idea that existing varieties could be made to accommodate themselves to special conditions and purposes, but that through hybridization new varieties could be produced to meet every purpose. At the first meeting of the London Horticultural Society, which he helped to organize, he read a paper[37] in which he set forth his views as to the purposes of the

[36] GOURLEY, J. H., Text-book of pomology. The Macmillan Company, New York, 1922. "The life and work of LUTHER BURBANK of Santa Rosa, California, has been a great stimulus to plant breeding. This is doubtless due to the great novelty of his creations and to the extent of his work. He has ever held in mind the production of fruits and other plants which would be of the greatest use and economic value and has held as secondary the accumulation of scientific data.

"Perhaps pomology has profited more from his production of Japanese plums, and the seedlings and hybrids which he has obtained from them, than from any other achievement. He has succeeded in hybridizing diverse forms of fruits, some valuable for commercial purposes and others as novelties."

[37] KNIGHT, THOMAS ANDREW, Introductory remarks relative to the objects which the Horticultural Society have in view. Trans. of the Hort. Soc., London, April 2, 1805.

Society and some of the things it should encourage its members to do. "Almost every plant," said he, "the existence of which is not confined to a single summer, admits of two modes of propagation; by division of its part, and by seed. By the first of these methods we are enabled to multiply an individual into many; each of which, in its leaves, its flowers and fruit, permanently retains, in every respect, the character of the present stock. No new life is here generated and the graft, the layers, and cuttings, appear to possess the youth and vigor, or the age and debility, of the plant of which they once formed a part. No permanent improvement has therefore ever been derived, or can be expected, from the art of the grafter, or the choice of stocks of different species, or varieties. . . . Seedling plants, on the contrary, of every cultivated species sport in endless variety. By selection from these, therefore, we can only hope for success in our pursuit of new and improved varieties of each species of plant or fruit. . . ."

Like BURBANK, KNIGHT's whole interest was in the production of useful plants but unlike BURBANK, he described his experiments in great detail at meetings of the Horticultural Society because he wanted the opinions of his colleagues. BURBANK rarely told anything about his projects until they were finished and then only in connection with the description of the new variety as he offered it for sale through the medium of one of his catalogs or price lists. His descriptions of his fruits and flowers were not those of a scientist, but that of a nurseryman. One looks for detailed and exact descriptions and finds a sales talk. His development might have been different had he not been compelled to sell his productions. He never took the trouble to make a report on his accomplishment to a horticultural or scientific meeting or to a scientific or popular publication. Why he did not we are left to conjecture. He has told us in his writings that he did not have time to keep detailed records on his hybrids or to write about them for publication. And this was probably true as he attended to everything in person and always kept himself overloaded with work but the unfortunate truth is that he had had no training in scientific procedure to give him an appreciation of the value of records or of having the results of his experiments mentioned in the scientific or technical literature of his day for the purpose of advancing knowledge and being helpful to others. This was the vital defect that prevented his being accorded the degree of fame he intrinsically deserved. Also, it undoubtedly accounts for some of his eccentricities. It is my belief that he did not want the opinions of others, and his nurseryman's instinct warned him to beware of disclosing what he regarded as his trade secrets to his rivals. He wasn't thinking of the public or the scientific world but of his fellow nurserymen. It is barely possible that he was seeking to emulate DARWIN who was a lone worker for many, many years before making known the results of his labors.

I have found no evidence to indicate that he was familiar with the writings of KNIGHT, FORSYTH or the famous Belgian hybrid-

izer, VAN MONS, who gave the world so many new varieties of pears. He was not only a lone worker but an individual or independent thinker. DARWIN gave him the idea of the possibilities of plant improvement and from this point he advanced alone, with supreme confidence in his ability to follow the paths DARWIN had pointed out. His program was original with him, he confided in no one, and did not even benefit by reading the history of what others before him had done.

One of the reasons why the institutional scientists of the country were chary of him was that he was not university trained, did not hold a degree. Institutional scientists the world over constitute a sort of caste system. They recognize that there are plenty of people with college degrees who are not productive scientists, but without a degree and the institutional training that a degree implies, it would be hard to secure a hearing, much less to be accepted. This is the first reaction of the institutional scientist toward the newcomer seeking recognition but I hasten to explain that scientists may be roughly divided into two groups, pure and applied, depending upon whether they are seeking the truth in the abstract or in the concrete, and those in the first group are likely to be less sympathetic toward BURBANK's accomplishments than those in the second. The first are chiefly concerned with fundamentals — the discovery of universal laws and precepts in the various fields of human knowledge without regard to their specific use, while the other may follow the same procedure or make use of the principles their colleagues have discovered, then proceed to apply them toward the solution of particular problems.

Pure scientists adorn some of the brightest pages of the world's history. Mostly they labor without hope of reward. Some have been martyrs. All honor to them, especially in these days when many are called but few are chosen. All young Ph.D.'s are zealous candidates. It has been science — pure science — from COPERNICUS and GALILEO onward that has been the torch that has led us out of ignorance and superstition. But to the applied scientists must go the honor for our greatest material advancement. Both are necessary. The applied scientist may use pure methods or pretend to do so. On the other hand, he may imagine that he is so pure that he would be dishonoring his cult and stultifying his talent to concern himself with things utilitarian. Happily these constitute a small minority. Privately endowed educational and research institutions employ thousands of scientists, mostly for the advancement of knowledge — non-utilitarian. Federal and state agencies maintain additional thousands on research status for humanitarian purposes — education, production and utilization of food and raiment, esthetics, better living — all essentially utilitarian. Agriculture alone in all its branches maintains a little army of research workers — between fifteen and twenty thousand — whose aims are principally utilitarian. These are employed by the United States Department of Agriculture and the agricultural colleges and experiment stations of the various states. Industry, too, both

corporate and individual, engages in research for its own ends — to become more efficient and successfully meet competition in a material world.

Research involves both philosophy and experimentation. Logic usually determines what the program of experimentation shall be but the technique to be followed may have to depend upon circumstances, upon technological knowledge, craftsmanship, equipment and the like. Research presupposes either wide intellectual training or special knowledge or experience in some particular field or domain. There are many degrees or grades of research, the lowest in scale according to present day standards being the empirical, or so-called cut-and-try variety. Up to fifty or seventy-five years ago much — perhaps most — of our material advancement was by this method for the good reason that popular education was not sufficiently advanced to equip workers for doing otherwise. It was not until about 1870 that chemistry was placed on a scientific basis by the acceptance of MENDELEEFF's periodic law, and another decade or so elapsed before "natural philosophy" was succeeded by the science of physics. A few students of that day, who enjoyed exceptional opportunities, were able to receive fairly good scientific instruction in animal physiology and anatomy but there was not much teachable knowledge of plant physiology and anatomy available until toward the end of the century. The science of genetics was not born until the rediscovery of MENDEL's laws of heredity in 1901.

BURBANK's formal education — such as he had — occurred when he was eighteen years old. He attended Lancaster Academy in his native village for a year, he tells us, perhaps the latter part of 1867 and the early part of 1868 — as country boys could be spared to go to school only in the fall and winter time. Old catalogs of the school now in the library of the American Antiquarian Society in Worcester, Massachusetts, show that his name was on the roster of pupils for both years. By present standards this seems like a sketchy education, but seventy-five years ago most boys were not able to do that well. He was fortunate in being located so near a famous school that turned out many notable men, for the Lancaster Academy, a high-class prep school for Harvard and Yale, attracted students from beyond the borders of the state. Just what subjects BURBANK pursued is not clear but he has said that he had thought of studying to become a doctor of medicine which indicates his scientific bent. Science subjects listed in the second, third, and fourth years of the Lancaster Academy curricula included mathematics — algebra, geometry, surveying, natural philosophy (physics), physical geography, and physiology. Unfortunately his schooling was cut short by the death of his father and he set out to make a living for his widowed mother by starting a market garden. In this pursuit he began his experiments in the hybridization of vegetables.

So far as we can see, BURBANK's schooling had little to do with determining his life work. However, it no doubt developed

his mind and broadened his horizon. He had a natural liking for plant improvement and his reading of DARWIN's books fanned this liking into a passion. He possessed the first requisite of a scientist — curiosity as to what would happen when two plants were crossed. There had been no influence in his life — educational or otherwise — to impel him to seek knowledge for its own sake and he was neither a philosopher nor a dreamer of idyllic dreams. On the contrary he was a practical-minded country boy with an urge to explore but who could see no reason why his findings should not serve some useful purpose. To do otherwise, to perform experiments for his pleasure alone, he would have stood condemned in his own eyes, as well as in the eyes of others, as an idler, a waster of time, a conclusion dictated by environment and upbringing.

It is interesting to speculate on what would have been the effect on his later life had he been able to spend a few months with AGASSIZ or ASA GRAY at Harvard — less than forty miles away — at this time. He might have followed the path of pure science. But fate decreed otherwise and he laid out a career for himself, according to his own lights, that was at once bold and unconventional; bold because he was evidently unfamiliar with what experimenters had done in Europe toward improving cultivated plants by means of crossing types and varieties; unconventional because our research institutions were unprepared by experience to endorse a program that grew so rapidly into monumental proportions.

While most of the states in the late eighties and early nineties were equipped with agricultural colleges and experiment stations — manned in all cases with college graduates — their experimental activities consisted mostly of variety tests, fertilizer trials, feeding experiments, and routine analyses — all quite empirical, which, in principle, was just what BURBANK, all alone and without a degree, was doing at his "Experiment Farm" out in California. True he was not testing varieties or making analyses but he was making wholesale crosses of types and varieties of fruits and other things by a hit-and-miss original method of his own and thereby producing (creating?) new varieties.

The experiment station workers with their limited number of tests kept careful account of their operations while BURBANK with his numerous simultaneous experiments had to be satisfied with only a pocket notebook with loose leaves on which he scribbled the merest outline of his doings from day to day and relied on his memory for the rest. Both achieved the results sought, in the sense that they, each, had visible and recorded evidence bearing upon the problem in hand but the station workers felt that their success was due to scientific procedure while the other was not. Tradition and training made this view inevitable.

As a class, institutional workers were instinctively mistrustful of BURBANK because he was unknown to the clan, had not attended their organization meetings or written for their publications, was unconventional in his experimental methods, and was an outsider.

When a considerable number of objections are cited in a case of this kind it is usually the last one that carries the most weight.

Institutional scientists have certain unwritten rules by which they judge themselves. These are commonly known and are well understood by all of the accepted scientists of the day. Because of the caste system then, it would have been almost as much of a miracle for BURBANK to be accepted by all of these aristocrats of knowledge as it was for the camel to pass through the needle's eye. If you are not to the manner born, so to speak, you are not apt to be taken seriously.

To be a scientist one must have been educated in an institution presided over by scientists. Back in the seventies and eighties and later, Germany was considered to be the land of science and scientists par excellence, and to that country flocked students from all over the world. Returning home, these students steeped in German methods and traditions quickly and effectively transplanted the German system to the laboratories of our leading institutions of learning to their everlasting betterment. But on bringing over their methods of undoubted excellence, they also brought along the German caste system as well, which was not so good. Of course, this caste system was never exactly reduced to a pattern as in our army regulations (also copied from Germany), and perhaps never consciously recognized as a caste; but we had it just the same and remains of it yet linger, here and there.

To belong to the caste, one must above everything be willing to conform. To be sure, as before stated, the rules are unwritten but in some respects they are as exacting or inexorable as the military code. The deplorable extent to which professional jealousy existed among European scientists, particularly in Germany thirty to forty years ago, appeared to me to be a concomitant of their caste system. During my student life and afterwards over a period of thirty years I had many personal friends in the faculties of three of their universities. In every case, where they had the opportunity of visiting our American institutions, they expressed astonishment at the way our scientific workers showed visitors through their laboratories and explained in detail their current researches, even though the visitor might himself be working in the same field. A few were inclined to be cynical and thought we were naïve. These would remark, "Are you not afraid they will steal your secrets?" Mostly, though, they liked our custom and deplored their own lack of confidence in their professional colleagues. I was told of cases where a visitor would discover that a rival professor was about to conclude a research when he would hurry home and rush into print with a paper, no matter how incomplete, in order to sterilize or at least to vitiate his rival's forthcoming report.

As a graduate student in Germany I had a closeup of some of their professional rivalry. In selecting a place to work it became necessary to make a choice between two laboratories in plant physiology, one presided over by a man 60 years of age with

an international reputation for his books and researches and consequently besieged by students, and another in charge of a man 12 years younger who was just beginning to taste the joys of fame and of course, with not so many students and these mostly persons who had been turned away from the other institution. For personal reasons, though mostly through chance, I elected to go with the younger man. When he learned that I had declined an invitation to work with his famous rival, I was received with a heartiness that I could not understand, but did later when I learned of the rivalry between the two. The attitude of my professor toward this colleague in a neighboring institution was not one of emulation but of pure envy. However, I deemed this to be no business of mine but I was an interested observer.

BURBANK was a scientist but not a conventional one. As one writer says,[38] "As a worker in applied science, BURBANK may be placed with other Americans whose originality and resourcefulness have led to notable discoveries as FRANKLIN, FULTON, MORSE, BELL, and EDISON."

"BURBANK was hardly a scientist in the stricter academic sense of the word," says HYLANDER,[39] "but as DAVID STARR JORDAN once said, 'It seems to me that Mr. BURBANK, while primarily an artist, is, in his general attitude, essentially a man of science. Academic he doubtless is not, but the qualities we call scientific are not necessarily bred in the academy. Science is human experience tested and set in order. Within the range of moulding plants, Mr. BURBANK has read carefully, and thought carefully, maturing his own generalizations and resting them on the basis of his own knowledge. In his field of the application of our knowledge of heredity, selection, and crossing to the development of plants, he stands unique in the world. No one else, whatever his appliances, has done as much as BURBANK, or disclosed as much of the laws governing these phenomena. BURBANK has worked for years alone, not understood and not appreciated, at a constant financial loss, and for this reason — that his instincts and purposes are essentially those of a scientific man, not of a nurseryman nor even a horticulturist. Scientific men belong to many classes; some observe, some compare, some think, and some carry knowledge into action. There is need for all kinds and a place for all'."

BURBANK himself has stated[40] that he thought of himself as a scientist, and oftentimes throughout his life he did knock at the scientists' door and demand admission. Feeling that he was a scientist and knowing that he had a long list of plant hybridization accomplishments to his credit, and having been told so many times by his admirers that he was a scientist, he could not understand why he was not welcomed into the magic circle. His enthusiastic

[38] COOK, O. F., Saint Luther, a BURBANK cult with an account of his wonder-working methods of plant breeding. Journal of Heredity, 20, 7:309-318, July, 1929.

[39] HYLANDER, C. J., American Scientists. The Macmillan Company, New York, 1935. Chapter on LUTHER BURBANK, pp. 105-122.

[40] HALL, WILBUR, Harvest of the years.

admirers also could not understand it. Unfortunately, some of the number advanced the theory — and it was generally accepted by the group — that there was a conspiracy on the part of the accredited scientists of the country, fostered by the institutions with which they were connected, to discredit him and keep him out. Jealousy was given as the cause and I have good reason for believing that BURBANK himself took considerable stock in this belief and I am quite sure that his last years were embittered because he thought he deserved, and had a right to expect, better treatment at their hands; it was tantamount to a betrayal, so in this state of mind there should be no surprise at his bitterness.

Without a conventional scientific education and having lived an isolated existence with his beloved plants, he was unacquainted with the standards of scientific men and how they judge each other and their work; how a man's rating does not depend upon his personality or what he says he has done or what others say about him unless they, themselves, are people of established reputation in the field of science and therefore thought capable of judging; so he could not possibily understand their viewpoint. On the other hand he was acquainted with the habits of nurserymen and florists who made a business of growing plants to sell. He knew their problems and how they were likely to react toward a competitor, that their envy might wax in proportion to the degree of his success as a vendor of plants; all of that he was familiar with, but he made the mistake of attributing ulterior motives to one group because he knew from experience that another group, for understandable reasons, might, on occasion, say unkind things about him.

I am convinced that BURBANK possessed the talent and attributes of a conventional scientist and there would have been no question about his acceptance had he been taken in hand when young and given the proper training demanded by the code. He was curious by nature, persevering, patient, and was endowed with a fertile imagination. He was bold, original, had a quick, discerning eye and apparently his powers of reasoning were good. His memory was marvelous as is attested by the multiplicity of his tasks and the meagre records he kept to guide his activities. In one respect at least, BURBANK did not display the attitude or spirit of the true scientist: there is no evidence he was ever stimulated by criticism. On the contrary, criticism or disagreement with him or his conclusions in any way always seemed to irritate him. To compare a variety of his fruit or anything else with a preexisting variety was taken by him as an implied criticism and he was quick to resent the slight, thus displaying his egotism at its best, or its worst.

Another reason why he was not looked upon as a scientist by many was that he did not have the attitude of a scientist; the basic urge he had for experimentation was utilitarian, to produce something that was salable rather than to make contributions to knowledge. One of the main reasons that he was not accepted as a scientist was that he did not keep proper records of his crosses.

His experiments were mostly uncontrolled. He rarely took the time or trouble to emasculate the flowers before applying pollen or to protect the hand-pollinated flowers from receiving foreign pollen through the aid of natural agencies such as wind and insects. In many instances he simply did not bother to find out where the pollen came from that fertilized his flowers because all he wanted was a large number of hybrids with as much variation as possible among them. This he knew from experience could be brought about by his method of wholesale pollination; and it may be remarked here that this was perhaps his biggest *direct* contribution to the science of plant breeding.

The idea was not original with him, to be sure. He got it from reading DARWIN. But he should be given full credit for developing the idea and demonstrating its truth and its practicability. It was this procedure that intrigued DE VRIES and caused that famous Dutch botanist to visit BURBANK in 1904 and again in 1906. Ostensibly he was on a lecture tour but BURBANK was the magnet that *drew him to California*. "For many years I had wished to make a study of fruit culture in California," wrote DE VRIES,[41] "and especially of the production of new varieties. One reason which, more than others, made me accept an invitation to visit California was the prospect of making the personal acquaintance of LUTHER BURBANK . . . .

"As soon as I had decided about my plans I wrote to BURBANK and told him my desire. I had previously been in correspondence with him, and a few years ago I had hoped to meet him at the Congress of Hybridologists in London, but his arduous labors prevented him from being present. I feared even now that there would not be many chances of speaking to him, because July is his busiest time, when all the numberless crossings are made and the selection of prunes [plums] takes place . . .

"My wish to see him was, however, met with the greatest cordiality. Others had naturally the same desire, and we were consequently all invited to come together to Santa Rosa, where BURBANK lives, and to inspect, under his personal guidance, his experimental plots. He set apart an evening and a whole day for our visit. How many crossings and selections he had to sacrifice for this I do not know. Our party was a rather large one. There was first Professor SVANTE ARRHENIUS — the man who with VAN'T HOFF laid the foundation of modern physical chemistry. Among all the savants I ever had the fortune to meet, he certainly is the man with the widest knowledge and the broadest interests, and his opinion about BURBANK's methods was of the greatest value to all of us. In our party was also the physiologist,

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[41] HUGO DE VRIES, A visit to LUTHER BURBANK. Popular Science Monthly, pp. 329-347, August, 1905. Authorized translation from the Dutch by Dr. PEHR OLSSON-SEFFER, Stanford University. "This article was written by Dr. H. DE VRIES, the eminent botanist and originator of the mutation-theory, while in California last summer. It was originally published in the magazine 'de Gids' in Holland, and forms a part of the third chapter of a book 'Naar Californië' by DE VRIES, which appeared recently in Amsterdam. . . . . "

JACQUES LOEB, the discoverer of many important phenomena in regard to fertilization in lower animals. His studies have led him to the question of the causes of life and of those life-functions which give animals and plants their characteristics, expressed in the differences of kinds and varieties. These characteristics cannot be studied to advantage except by means of hybridizing. So far no one in the whole world has made crossings on a larger scale than BURBANK, and it was only natural that there should be many points in common between the studies of both these men. Our party was under the guidance of Professors WICKSON and OSTERHOUT, of the University of California. Both are personal friends of BURBANK, and, notwithstanding the distance, often visit him to keep posted on the progress of his work.

"In outward appearance BURBANK is a very plain man, more a gardener than a savant, with clear blue sparkling eyes, full of life and fun, appreciating humor in others, telling us stories that kept us constantly laughing. He lives in a small house with his mother and sister, and has but one servant on the place, as he does most of the work personally. The walls of his room are covered with small photographs of his victories, and during our visit these pictures were taken down and demonstrated to us."

DE VRIES then discussed the extremely large numbers of hybrid plums BURBANK dealt with in producing the Alhambra variety, also his experience in crossing the wild beach plum with other American varieties as well as with the Japanese in order to combine the hardiness of the first with the eating qualities of some of the others.

"It is natural that by such crossing we must expect the appearance of undesirable characters as well as desirable ones. Some plants produce only good, others only bad, characters, but the greater part exhibit some good points in connection with a larger or smaller number of undesirable qualities. From hundreds of thousands only those must be selected which possess all the desired characters. To make this possible it is necessary not only to cross six or eight kinds with one another, but to use as many sub-species and varieties as possible for the experiments. This work necessitates hundreds and even thousands of experiments. The result of each crossing can only be judged by the fruit, and this indicates new combinations. It can easily be seen what an immense amount of work, patience and capacity of judgment and choice is required to reach the ultimate aim. Yet BURBANK told us on that remarkable evening of many such instances. He was enthusiastic in his hope to be able to realize all this during his life.

"The making of hybrids from the different species of plums naturally brought us to a subject which, for me, was of the greatest importance from a scientific standpoint. As ARRHENIUS and LOEB also felt more interest in the theoretical side of these problems, I took the first opportunity to bring the conversation *to that point. I had in mind the 'pitless prune'. . . . When asked how* it was possible to bring about such a great change (seediness to

seedlessness), that hybrids do not present, as a rule, any new simple qualities, only new combinations of already existing properties, BURBANK explained that he merely brought a natural *'prune sans noyau'* (plum without seed), from France, where it had been known as a worthless wild fruit growing in the hedgerows, and hybridized it with varieties possessing good eating qualities. Thus there is no exception to the rule, there has been no real production of a new character...

"To Professor LOEB and myself this was, to a certain degree, a disappointment. We had expected to learn a great deal about this point, the fundamental idea, if not ultimate aim of the studies of both of us — that is, the question of the nature and origin of new characters. We now surmised that BURBANK's experience did not throw any light on this question."

The case of "white blackberries" was also cited and discussed and it developed that again he had made use of a natural wild form with white fruits. Then came the "spineless" cactus and it turned out that he had collected Opuntias from Mexico, South Africa, and various countries as well as the commonly cultivated species. "Among the specimens BURBANK received, one was accidentally found without prickles on the leaves and another with no thorns on the young shoots. It was, therefore, necessary to combine in one plant both these negative characteristics, something that experience has shown can be done...

"What makes BURBANK's work entirely different from that of other plant breeders is the immense scale on which his selecting is made. He is, therefore, able to make greater improvements than others and in much shorter time. In his work BURBANK is guided by a special gift of judgment, in which he excels all his contemporaries. The best proof of this is to be found in the great success his creations have made, not only in North America, but also in Europe.

"His methods of work are the same as those followed by plant breeders in Europe. Secrets he has none, and if he is not willing to demonstrate his cultures to everybody, this must be attributed to the fact that his time is too valuable. There is no fear that anyone could 'steal his trade' by merely looking at it. Everyone is left free to follow in his path, but without the special disposition for it nobody will succeed, and for simple imitation, the entire process is too complicated...

"With crossing or hybridization we usually understand the sexual union of two individuals belonging to different species or varieties. In practical plant breeding, however, it is not sufficient to combine two types, but three, four, and even five, or six kinds are thus united, so as to bring out as many desirable qualities as possible in one single variety. It is, of course, impossible to predict what result will be obtained, and it must be left to chance and the future to decide what combinations are the most desirable. Often crossings are made only with the object in view that among all the combinations something good may turn up. In this case

the breeder wants to destroy the equilibrium of existing characters, to make the constant forms unstable, and then to select the best out of the many balancing properties. When the parents themselves are variable their offspring will naturally be more so, and the number of differences increases with the number of hybrids experimented upon.

"There is also a chance that latent or sleeping characters may be brought to light. From a scientific point of view we know, as yet, nothing about this, but BURBANK holds the opinion that in many cases one character prevents another from becoming visible. For instance, in crossing, the first one meets an opponent which has kept it back — as is often the case in the crossing of varieties — and this latent character gets an opportunity of becoming active. We can naturally not detect what dormant qualities are hidden in a plant, and may, therefore, expect all kinds of surprises. The combinations may be desirable, and the hybrids can be propagated immediately, or they may be the reverse and need further crossing before the unfavorable traits are eliminated. Unknown atavistic properties may in this way become evident and may play an important part in the development of future generations.

"In other cases the crossings are made with a certain purpose in view. These are the instances from which we learn the most, and which at the same time give the best chance for quick and favorable results. A certain number is selected of species or varieties, which together contain those characters we want combined in one type: The undesirable properties we try to eliminate. As the crossings result in all kinds of combinations, it is necessary to produce them in as large numbers as possible, so that among the numberless undesirable and imperfect plants we may choose the best. The chances are that from the five or six desired good characters only three or four are found together. Thousands of seedlings have to be developed in order to create a possibility of finding one form in which the expected qualities are present. It is a game of solitaire on a large scale. I may mention as an example of this the production of the Alhambra plum, which was obtained by combining European, American, and Japanese kinds. It took thirteen years to combine all these. First came the crossing of the Kelsey with the *Prunus Pissardi.* Their hybrid was crossed with French prunes. In the meantime various other crossings were created, and it was made possible to work the pollen of these 'into the strain' as the term is called. First came *Simonii, triflora, Americana,* and then *nigra.* This sevenfold combination gave us the variety now known in the market as the Alhambra.

"We can go still further and cross species that are yet more widely separated. It is then naturally even more difficult to predict the results. BURBANK endeavored to combine the plum and the apricot and succeeded in getting a new fruit, which he calls plumcot, of very delicious taste and looking very much like an apricot, but combining the soft skin of this fruit with the dark color of the plum. BURBANK had a number of varieties of his

new fruit, some with a yellow fruit-flesh, others of dark red color, light rose, or white. In taste these plumcots differ considerably. . . .

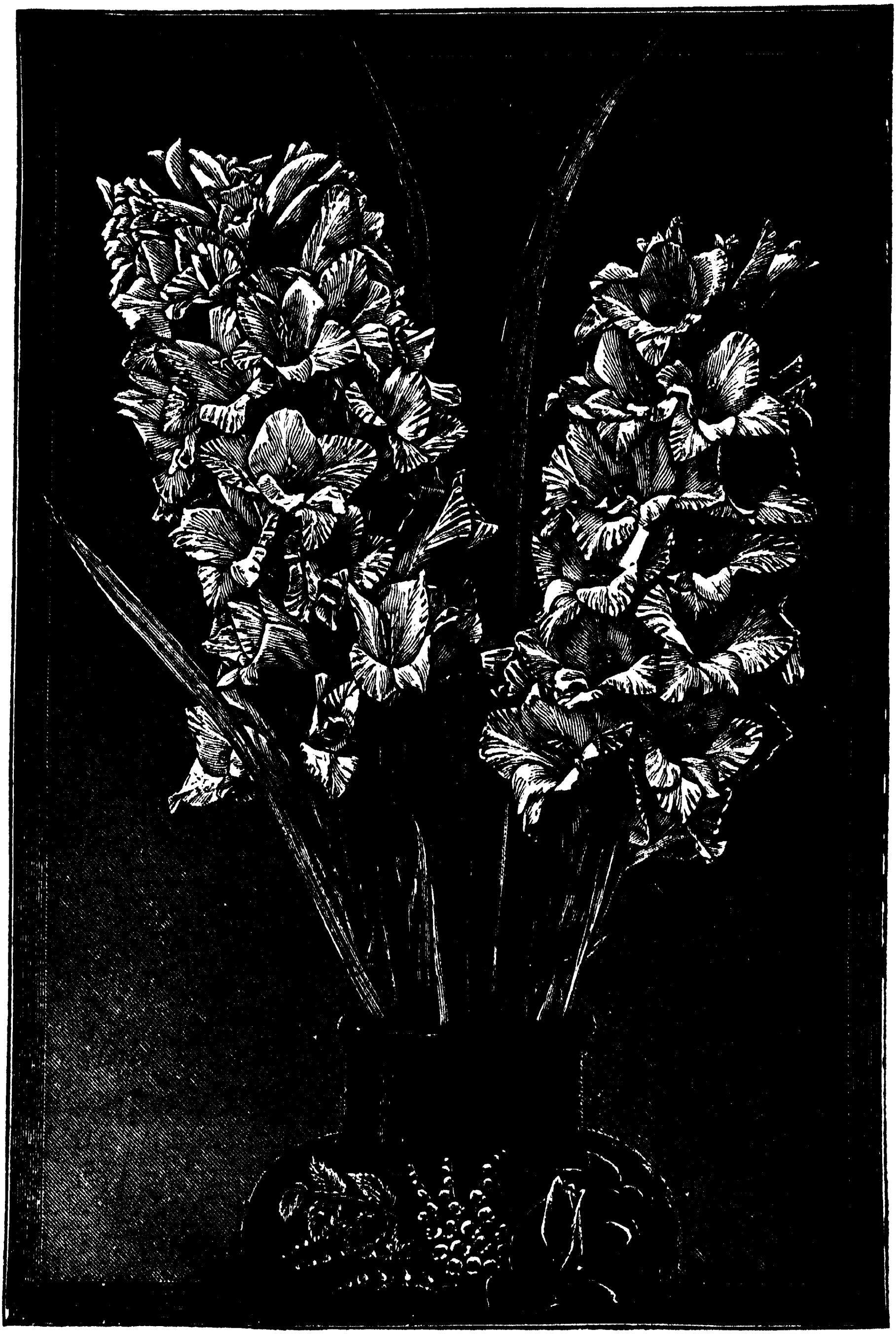
"When novelties are wanted in varieties of begonias, geraniums, dahlias, or fuchsias, for instance, which annually produce many new forms, the hastening process would be of no value, but in new genera unexpected results are often attained, and in that case the hastening method will amply repay the expense. Yet these questions are the secrets of breeders. Of scientific importance is the question whether repeated selections are alone sufficient to bring about the same end, and further if by this means more variations are produced.

"We have no facts which would decide this, and I would not have brought up the question, had it not been for its great influence on the study of evolution. It is closely connected with the question whether species slowly merge into one another or whether they originate by mutations. In the former case small deviations would increase in the course of generations, and thus a long series of intermediate forms would connect the new and the old species. In the latter case a jump is made without any intermediate stages. So long as there were not sufficient instances of this mode of change, and so long as we had to rely upon cultivated varieties only as proof, the first proposition was naturally the most probable. It rested on experience in agriculture and horticulture in regard to improvements of races, and it was believed that species in nature originated in the same manner. The result of breeding on such a large scale as that mentioned above was at the time unknown, and it was believed that the results could be obtained only by repeated selections. If by experiments on a large scale the varieties could be produced at once, the former view would evidently lose much of its value.

"The magnitude of BURBANK's work excels anything that was ever done before, even by large firms in the course of generations. The number of fruits and flowers which he has improved is unequaled. Others confine themselves to one or two genera; he takes hold of everything. The majority of breeders who became famous by their improvements of certain groups took up this work merely as an adjunct, as a means of widening their commercial relations, thus creating a greater demand for their nursery products. BURBANK commenced in the same way, but as soon as he had obtained what he thought he required, the nursery business was abandoned, and he devoted himself exclusively to the improvements of flowers and fruit. It is to this resolution he owes his present fame."

This analysis of BURBANK's principles and methods of breeding is the best that has ever been made. DE VRIES came over with the thought in mind that many, perhaps all, of BURBANK's new plant forms could be attributed to mutation — abrupt appearance of new characters — but he soon abandoned this idea, chiefly because he had not produced new characters at all but had merely

A sixty-year-old Royal hybrid walnut growing in the dooryard of the JOSEPH W. MILLER home in Santa Rosa, California. Planted about 1884, this is believed to be one of the first five hybrids between the common black walnut of the eastern states, *Juglans nigra*, and the Northern California black walnut, *J. californica* var. *Hindsii*. In 1939 the tree had a circumference of ten feet, a height of one hundred feet, and a branch spread of 75×96 feet. It has produced a ton of nuts in a single crop. (*Photograph by* Mr. ARTHUR E. GILMORE.)



California.

One of the few wood engravings used in Luther Burbank's catalogues showing the *Gladiolus*, variety California ("the first double Gladiolus and the first of a type in which the flowers are closely arranged all around the spike like a hyacinth . . .") from "New Creations," p. 42 (1893).

re-combined existing old ones since this was all he claimed to have done; there was no new scientific principle involved and, therefore, no mystery about his accomplishments. However, DE VRIES made it clear that he greatly admired the man for what he had done and gave him full credit for having demonstrated the possibilities of mass breeding.

On the other hand, on the scientific side he expressed some disappointment, as has been stated. In addition, he privately expressed his disappointment, both on account of no new characters having been developed by BURBANK'S methods of breeding and on account of the scarcity of records. These regrets were made known to a young Dutchman by the name of JOHN ZUUR, who was just over from Holland, working for BURBANK as a gardener's helper. At that time ZUUR understood the English language fairly well but could not speak it. No doubt it was a kindred feeling toward a fellow countryman who could converse in his native tongue that caused DE VRIES to speak so frankly to a stranger. At any rate ZUUR, who still resides in California, tells me he did so.

Still another and very potent cause of mistrust of BURBANK in the eyes of institutional scientists was his connection with schemes to merchandise his products. His nursery instincts and the rules of the game caused him to make prodigious claims for things he had to sell. And when he sold an individual or a company the exclusive right to market his productions, as recounted elsewhere, he got the credit for all the things that they said and did. No man can be thought of as a true scientist who would make the claims he or his agents did in order to sell something.

These merchandizing stunts, with their attendant publicity, alienated the sympathy of many who, otherwise, would have been his supporters. I have found it to be a fact that some, although knowing he had originated numerous valuable fruits and flowers, were, on account of the things that have been narrated, still inclined to mistrust even this positive evidence of his value to human welfare, and finally allowed themselves to come to the conclusion that perhaps, after all, BURBANK was the shady character that the extreme critics all along had said he was.

Further reason why BURBANK was mistrusted by scientists was his proneness to go off at a tangent in his thought, as evidenced by his incursions into speculative philosophy, metaphysics, and psychology.[42] [43] HUGO DE VRIES once criticised him "for making statements on subjects outside of his field; the wrong he had done to himself because he wanted to give to his work scientific significance."

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[42] ATKINS, ALBERT J. and EMMA A. LEWIS, The mystery of gravitation explained. Refers to it as electric action. LUTHER BURBANK approves main principle of theory. San Jose Mercury, November 19, 1905.

[43] FAIRCHILD, DAVID, The world was my garden. Charles Scribners Sons, New York, 1939. "I was surprised and nonplussed to find that BURBANK believed in clairvoyance."

DE VRIES had reason for being doubly disappointed at his visit with BURBANK, for he not only did not learn any secrets about how new plant characters are acquired but his own pet theory that they arise through mutations received a severe jolt. As stated before, BURBANK did not claim to have created new characters in his breeding operations but merely to have brought about recombinations of characters that had previously existed either in the parents or some of their ancestors. (Examples, the so-called pitless prune, white blackberry, scented lily, spineless cactus, and many others.) Of course, little or nothing was known about chromosomes and genes in 1906, and their significance as carriers of hereditary traits. These were discoveries of a later date. While DE VRIES was undoubtedly familiar with the structure of the living plant cell and at certain times may have observed a cloudiness in the nucleus — may have even heard of chromosomes — it is certain that BURBANK had never seen or heard of such things. I have found no evidence that he ever possessed a microscope or even read the scientific literature of his day. He did, however, have a vast fund of knowledge on the behavior of plants gained from twenty years' experience in hybridizing and searching for certain characters in the seedlings. And there is much proof that he was a careful observer. A man of keen vision and active mind, ever on the alert to find even minute characters that would serve as clues to the ultimate value of the plant, it is not surprising that he was able to find at least a few characters in seedlings that turned out to be correlated with adult characteristics. This faculty of observation was assiduously cultivated because it was necessary to find short cuts in his work, to get more done in a shorter time.

At one time or another he has had much to say about this gift and there seems to be considerable direct evidence favoring his claims although even scientific visitors have been prone to place too much credence in his own statements at times, not knowing or realizing that he was much given to exaggeration. DE VRIES gave him credit for possessing a special talent in selecting young seedling trees for future usefulness and exceptional judgment in picking from a large collection of hybrids, after fruiting only once, certain ones that later turned out to be successful varieties. As this was the period when BURBANK was originating his long list of varieties of Japanese plums, DE VRIES evidently referred to that fruit. But BURBANK probably never had an easier task in picking winners as Japanese plums at that time were practically unknown and thus the meanest of his seedlings were better than existing varieties. The Kelsey, introduced from Japan in 1870 by JOHN KELSEY of Berkeley, California, and disseminated by J. F. HOUGH of Vacaville, California, was our only variety, and this was so tender that it was not grown outside of California and therefore was known only locally. Other seedlings were brought in by W. P. HAMMON and H. E. AMOORE, under Japanese names, but apparently they soon disappeared.

KELLOGG[44] thus testifies to BURBANK's acumen in judging his material: ". . . . there is always immediately following the usual production of variations, the recognition of desirable modifications and the intelligent and effective selection of them; that is, the saving of those plants to produce seeds or cuttings which show the desirable variations and the discarding of all the others. In BURBANK's gardens the few tenderly cared for potted plants or carefully grafted seedling represent the surviving fittest. . . .

"It is precisely in this double process of recognition and selection of desirable variations that BURBANK's genius comes into particular play. Right here he brings something to bear on his work that few other men have been able to do. It is the extraordinary keenness of perception, the delicacy of recognition of desirable variations in their (usually) small and to most men imperceptible beginnings." This was high praise from a man who was an able scientist, young and critical. KELLOGG afterwards became permanent Secretary of the National Research Council.

Under the heading of "Correlation of Parts" BURBANK is reported by WILLIAMS,[45] his ghost writer, as having observed the following relations and correlations: "In selecting raspberry and blackberry plants for color of fruit, for example, there is almost always a correlation of the plant and fruit that will foretell the future crop. . . . I have observed that vines that have purple spines and canes will in future produce berries that are dark purple or dark red in color. Pinkish leaves, on the other hand, foretell fruit of light pink or red color; plants with reddish vines and foliage may be expected to produce berries of a yellowish color. Very pale foliage and canes usually indicate that the crop will be of a whitish or amber color. . . . .

"The correlation of characters between the vine and the fruit of the grape is not always quite so clearly established, yet it is often observable. Grape tentacles may give clear indication of the size and flavor of the future bunches of fruit. Long before a grape vine has come to the age of fruiting, the taste of the tendrils may give a fair idea of the flavor of the grapes it will ultimately bear. Moreover, the seedling vines that produce bush stems that are small and much branched, and have small leaves, will almost invariably produce meager clusters of small fruit of poor quality.

"Among plums and peaches the correlation of characters is exceedingly valuable. The case of plum seedlings, already cited where he walked down a nursery row and marked little trees a foot high either for acceptance or rejection — destruction — by merely giving them a glance, and where he did essentially the same thing by passing quick judgment on a lot of plum seedlings

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[44] KELLOGG, VERNON L. and DAVID STARR JORDAN, Scientific aspects of LUTHER BURBANK's work. A. M. Robertson, San Francisco, 1909.

[45] LUTHER BURBANK, his methods and discoveries and their application, by LUTHER BURBANK, edited by HENRY SMITH WILLIAMS. The Luther Burbank Press, New York and London, 3: 285-289, 1912.

that had been uprooted, which he placed in three piles — good, promising, and worthless — suggests the possibility of pre-judgment of fruit from observation of small seedlings. There are a good many characters of leaf and twig that are almost too intangible for description, like the changing expressions of the human face, or like delicately graded colors, yet which to the practical eye are full of meaning. . . . It may be expected that a plum or peach seedling having foliage of a reddish-purple color will produce fruit dark-colored not only in skin but in flesh. . . ."

SHULL, who collaborated with BURBANK for several years, and is perhaps better posted than anyone I know of to speak of his working habits, is inclined to discount most of the statements of visitors and even of BURBANK himself as to his ability to judge seedlings by means of correlative characters but it should be remembered that SHULL is a geneticist — an eminent one and a pure scientist — whose interests lie in the direction of discovering and formulating laws or other fundamental concepts of heredity, and therefore may be rated as a severe critic. He writes[46] "Regarding the ability of Mr. BURBANK to detect correlations between seedling characters and adult characters of flowers or fruits, my conclusion has been that although there is a basis for the story, the correlations involved are very general and not specific. Mr. BURBANK's own statement regarding the basis for his putative canniness in selecting in the seedling stage, was that if the seedling shows lush growth, thick stems, and fat smooth buds, the subsequent growth of such plant can be expected to give larger and better fruit than if the seedlings show a tendency to have thin, spindly stems, and narrow buds. The tales of wizardry that have been built on this general correlation were figments of the imagination — probably figments of Mr. BURBANK's own imagination, primarily, but also of the more or less imaginative reporters of his prowess."

In my contacts with scores of scientists — both pure and applied — in the course of these studies, I have found geneticists as a class to be the most critical of BURBANK's worth to society, but upon closer examination it develops that they always judge him by the same standards they apply to themselves. In other words, the first reaction of the pure geneticist to the question of a man's worth as a breeder of plants or animals is whether he has discovered new truths or advanced our knowledge in this field of endeavor, and not whether he has improved our living conditions in a social or economic way. He does not deny the need or desirability of having improved varieties and types of plants or animals for one purpose or another — not at all — he simply is not interested; his life's endeavor lies in another direction. The practical breeder, like BURBANK, is intent upon producing new things for some utilitarian purpose. Another geneticist,[47] who had visited

[46] Personal letter, November 11, 1939.

[47] JONES, D. F., BURBANK's results with plums. Journal of Heredity, August, 1928.—Life and work of LUTHER BURBANK. Spragg memorial lectures on plant breeding. (First series.) Department of Farm Crops, Michigan State College, East Lansing, Michigan, p. 57, 1937.

BURBANK, made some study of his work. A few of Dr. JONES' views are set forth below:

"BURBANK's incontrollable characteristic of over-statement, his uncritical attitude towards his own work and gross exaggeration of facts, together with misstatements and the ridiculous nonsense of HARWOOD, WICKSON, and other writers about his work, have naturally led to an over-critical attitude on the part of most geneticists and horticulturists as to the real merits of a man who was sincere in efforts, personally charming, and extraordinarily industrious."

Dr. JONES castigated BURBANK for claiming to have observed a case of what he called sap-hybridization. A scion from a purple-leafed plum was grafted on a green-leafed plum tree, and although the branch did not bloom, some of the seedlings from the tree itself showed colored leaves. "Although BURBANK had no doubts about this being a case of hereditary influence of the scion on the stock he can hardly expect all fruit growers to share his confidence."

He also denied the validity of BURBANK's claim to having demonstrated that teosinte was a primitive form of maize and had grave doubts that he had successfully hybridized corn and sorghum. And further, "his theory that hybrid vigor is an atavistic return to the vegetative luxuriance of plant growth in the Mesozoic era is a laughable instance of wild speculation that hardly helps to understand this phenomenon. Heredity that remains dormant for a million generations and then comes to light on crossing would be a far more remarkable event than the invigorating effects of hybridization itself."

BURBANK did like to philosophize. JONES thought that he had been greatly influenced when a boy by RALPH WALDO EMERSON's essays and caustically remarks that in his statements, "There is much more influence of the philosopher of Concord than the eager observer on the Beagle."

BAILEY, the botanist and prolific writer of horticultural books as well as treatises on plant physiology and plant breeding, envisioned the viewpoints and purposes of both the theoretical and applied breeder. Having visited BURBANK and made a study of his methods and accomplishments he has this to say about his ability to make successful selections from his multitude of seedlings:[48] " . . . . The judgment as to what will likely be good and what bad is the very core of plant-breeding. In this judgment BURBANK excels. Not to many men is given this gift of prophecy. BURBANK calls it intuition. He cannot explain it any more than another man can explain why he is a good judge of character in human beings. Long experience and close observation have directed and crystallized this faculty of his, until it is probably as unerring as such faculties can be."

Professor BAILEY's impressions of BURBANK's discernment are of particular value because he was not only a famous teacher of

[48] BAILEY, L. H., A maker of new fruits and flowers. World's Work 2:1209-1214, 1901.

his time (the eighties and nineties), but himself enjoyed a rather wide reputation as a keen observer and for his perspicacity in estimating values from external characteristics in both people and things that came under his notice. With this in mind, and for the further reason that BAILEY had an extensive personal acquaintance among plant breeders and was familiar with the literature of his day on evolution and breeding, it will be of interest to hear his general summation of BURBANK:[49] "LUTHER BURBANK is a breeder of plants by profession, and in this business he stands almost alone in this country. . . . So many and so striking have been the new plants that he has given to the world, that he has been called the 'wizard of horticulture.' This soubriquet has prejudiced many good people against his work. LUTHER BURBANK is not a wizard. He is an honest, straight-forward, careful, inquisitive, persistent man. He believes that causes produce results. His new plants are the result of downright, earnest, long-continued effort. He earns them. He has no other magic than that of patient inquiry, abiding enthusiasm, an unprejudiced mind, and a remarkably acute judgment of the merits and capabilities of plants.

"Personally, LUTHER BURBANK is rather small and spare of stature, somewhat stoop-shouldered. He is inclined to be slow of movement, but he is very quick of perception. He is an intent listener. He is inclined not to talk of his work, but to one who has a genuine interest in his experiments he talks freely and frankly, but never boastfully. He likes to dwell on his failures and the delight that the guest has given him. He shows you his plants, tells you how he produced them, then allows you to make your own judgments of their merits. You feel his kindly and gentle spirit, and before you know it you love him. . . ."

The foregoing paragraph suggests another thought: the great difficulty, if not impossibility, of discussing BURBANK objectively if the writer has known him intimately, or, sometimes, only casually. Many have testified to the magic of his personality. FAIRCHILD[50] almost complains of this as he tried to analyze the man after a two-day visit: "One might describe BURBANK as like TOLSTOI, in that, when one was with him, one felt the strange force of his simplicity and his profound confidence in his own abilities. But, on leaving him, the impression faded, and one began to wonder wherein lay his power, for his results did not quite seem to justify his claims."

Both BAILEY and FAIRCHILD are kindly men. The former is a poet as well as an interpreter of science, while the latter, although of the artistic type, endeavors to be more coldly analytical in his pronouncements. That is why he seems to have been somewhat annoyed at himself. A struggle of the head against the heart.

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[49] *Ibid.*

[50] FAIRCHILD, DAVID, The world was my garden. C. Scribner's Sons, New York, 1938.

Now, it may be asked, after hearing all the evidence, what do I think of BURBANK as a scientist? My reply is that it depends upon the particular meaning we may give to the word. If we strip the several definitions down to bedrock and say that science is knowledge, and that a scientist is one who advances knowledge, then I should not hesitate to say that BURBANK qualifies for the mythical crown. His genius lay in the direction of demonstrating and proving old truths rather than discovering new ones. The fact of variation in plants was established by DARWIN and generally accepted. He also pointed out the how and the why of variation through cross pollination, and the possibilities of improvement through natural selection, but it remained for BURBANK, alone, undirected, and unaided, to demonstrate these truths on a scale so grand and complete that it has been the marvel of the age. The fact becomes even more noteworthy, because to BURBANK DARWIN's pronouncements were in the nature of theories. So far as I can determine, he was not familiar with the work of KNIGHT, SHIRREFF, NIELSON, VAN MONS, the VILMORINS, and other plant improvers in Europe. To BURBANK the corollary of variation and selection was the production of new types and varieties of plants that would be useful to man. During the first fifteen or twenty years of his breeding activities it probably never occurred to him to try to formulate laws of heredity. He was only interested in obtaining new and useful forms as quickly as possible by causing his plants to vary and then perfecting his technique of selection. I repeat that during this period little was known about rules and laws of inheritance of characters. European breeders were already groping in this direction but BURBANK was unaware of the trend.

After 1901 there was much ado about the recent rediscovery of MENDEL's classical experiments of a generation earlier and the laws of inheritance of characters that he laid down, but BURBANK was unimpressed. He took little stock in the new theory — disbelieved it, in fact, because he had been successful without knowing anything about it. And neither did he set much value on the mutation theory of DE VRIES. He preferred to stick to the principles of DARWIN. He cared nothing about laws; what he wanted was results. ". . . . To would-be plant experimenters who ask my opinion of matters connected with the old versus the new interpretations of heredity (Darwinian vs. Mendelian), I am accustomed to say:[81] 'Read DARWIN first, and gain a full comprehension of the meaning of Natural Selection. Then read the modern Mendelists in detail. But then — go back again to DARWIN'."

He then relates that[82] ". . . . just at the close of the nineteenth century, Professor HUGO DE VRIES came forward with his 'mutation theory', it had all the force of a new doctrine, and was even thought by some enthusiasts — though not by its originator — to

[81] LUTHER BURBANK, his methods and discoveries and their practical application, 2: 70-71.

[82] *Ibid.*, p. 90.

be in conflict with the chief Darwinian doctrines." He declares that DE VRIES never thought of his theory in any sense as contradicting the Darwinian theory of natural selection. On the contrary, it is to be regarded as supplementing and supporting that theory.

DE VRIES accounted for the occurrence of mutants in his primrose as being probably due to altered conditions of nutrition and thought that all species probably are subject to mutation periods.[53] "It was recognition of the difficulties thus presented, undoubtedly, that led Professor DE VRIES to devise the rather visionary hypothesis of *periods* of mutations. . . ."

"In a word," said BURBANK, "the varied tribes of evening primrose which Professor DE VRIES developed in his gardens at Amsterdam were overwhelmingly suggestive of various and sundry new forms of hybrid plants that I myself have developed year after year in my experimental gardens at Santa Rosa. . . . Over and over again, hundreds of times in the aggregate, I have selected mutants among my plants, and have developed from them new fixed races. But in the vast majority of cases I knew precisely how and why these mutants originated. They were hybrids; and they were mutants *because* they were hybrids. And so from the outset, I have believed that Professor DE VRIES' celebrated primroses had the same origin."

This was BURBANK's attitude at the turn of the century and despite the advent of Mendelism he continued to have faith in the Darwinian theory of plant evolution. But something happened about 1912 to make him appear inconsistent. At this time an organization known as the Luther Burbank Society was formed by promoters to exploit the life and writings of BURBANK. To this end a professional writer, HENRY SMITH WILLIAMS, was engaged to edit a twelve-volume set of books to be entitled "LUTHER BURBANK, His Methods and Discoveries and Their Practical Application", which was intended to be an autobiography. The scheme was an exceedingly ambitious one with many ramifications (Chapter VIII). BURBANK was supposed to do the writing. Actually he devoted two or three hours a day to dictating answers to questions that were propounded to him by the editorial staff headed by WILLIAMS. Supposedly the books were prepared from this material. There is much evidence to show that the editors took so many liberties with the statements, and put so many words in his mouth, that it is often difficult to tell who is speaking, BURBANK or the editor. I am well enough acquainted with BURBANK's style and idiom, from reading his catalogs, papers, and letters to feel that I can identify the true as well as the false, including subject matter, phrasing, facts, and manner of statement. It was the task of the editors, at the behest of the promoters — not BURBANK — to make him a world character as a scientist, and BURBANK fell in with the plan. By nature BURBANK was of a modest,

[53] *Ibid.*, p. 96.

retiring disposition; hated personal ostentation and display (such as heading parades and appearing before large audiences), and avoided the limelight where possible. He, however, thought highly of his own achievements, did not stint words when writing about them; desired commendation and approval; was highly susceptible to praise; allowed others to go as far as they liked in writing about him; so the stage was set for WILLIAMS and his cohorts to play him up to the public in accordance with their own ideas. This was a rare opportunity for a writer of WILLIAMS' skill. Even though BURBANK furnished him with tens of thousands of words — in answers to questions — the insatiable editor did not find this enough for his purposes. In discussing the scientific aspects of plant breeding he interpolated paragraphs and sometimes whole pages of his own ideas, palpably not BURBANK's. In the course of some of these perorations the editor became so enthusiastic in unfolding his ideas that he unconsciously stepped out of character and referred to BURBANK in the second person, whereas it was intended for the reader to believe that the books were written by BURBANK and that, at all times, he was the speaker.

For editorial reasons, then, BURBANK was made to discuss scientists and scientific theories that he knew little about — and I fear, cared little about — and to make statements he most likely would not have made of his own volition. The books were prepared for popular — yes, very popular — consumption so it was necessary to make them easy to read. The editor was proud of his ability to popularize science — in fact, he was no doubt hired because of success in that direction in the course of his career as a compiler of popular books. He was apparently a man who had read widely, much more so than BURBANK could have found the time to do had he had the inclination, so he knew the names in the scientific world both past and present as well as the patter, but his handling of BURBANK's career did not enhance the latter's reputation as a scientist. The BURBANK books prepared by WILLIAMS and his helpers did serve their major purpose no doubt — that is, to sell, or rather, to fulfill a pledge to the subscribers, in a doubtful membership scheme of the so-called Luther Burbank Society. The membership of the Society as a class consisted of worthy people who were wholly unlearned in science. For the most part they were nature and garden lovers who must have been fascinated with the beautiful stories of BURBANK's accomplishments. The most commonplace incidents in a gardener's life, such as budding and grafting, were made to appear marvelous.

Apparently BURBANK had been instructed to tell what he had done and how he did it, including the technique employed, to the end that each reader might take up the work of plant improvement where BURBANK left off and carry it forward to infinity. BURBANK was naïve enough to take the assignment in dead earnest. He believed that he was performing a service to humanity comparable to what he had accomplished in giving to the world a long

list of new fruits, flowers, and other useful plants. Of course, monetary profits would accrue, to the promoters at least; where BURBANK was to come in is not clear. But I am convinced it was not the money inducement that caused him to enter upon this herculean task. Justifiable pride was one factor, but the controlling motive I believe to have been that of Service. He is on record as saying, "My aim in this work is to benefit mankind. If I receive enough material returns to pay my expenses I am satisfied, for I feel there are so few who can improve our fruits that it is my duty to fulfill my plans."

With much prodding he went through with his part of the program but it was almost too much for his strength as he was at the same time trying to carry on his usual work of plant breeding. Whether he was pinched for funds to run his business I do not know. His income of $10,000 a year from the Carnegie Foundation had been cut off two or three years before but he had not yet begun to lose the income from his products by reason of his deal with the Luther Burbank Company which happened a year or two later.

He probably profited very little from the schemes of the Luther Burbank Press and Society. Although they published the twelve-volume set of books[64] the promoters were not satisfied but immediately launched grandiose plans for special editions in translated form for six foreign countries, and after that at least six different editions ("with perhaps different kinds of bindings")[65] that would appeal to particular groups in this country. Finally they envisaged a line of textbooks for "schools and high schools, colleges, agricultural colleges . . . the general public all over the United States is actually hungry for the Burbank books, giving information upon these new plant-breeding methods..." (Chap. VIII). But about this time the over-distended bubble burst — the beautiful dream vanished — for the publishers, the Luther Burbank Press, were thrown into bankruptcy.

The Luther Burbank Society's books further helped to confirm BURBANK's widely spread reputation as a popular idol, but the number of persons that read them, relatively speaking, was not great, on account of their cost, which to the subscriber was $181 a set. The damage the books did to his reputation in scientific circles was incalculable as they helped to confirm previous opinions that he was, from the scientific viewpoint, a slipshod workman. The books related a host of dogmatic facts but failed to give essential information.

Another harmful effect of the books will go on and on because the matter contained in them will be used as the authoritive views of BURBANK. I concede that his various accomplishments are listed and described approximately as he gave them or would give them,

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[64] LUTHER BURBANK, his methods and discoveries and their practical application.

[65] Santa Rosa Press-Democrat, Santa Rosa, California, October 9, 1912.

and sometimes in approximately his own words, but the opinions of the editors, masquerading as BURBANK, are both fatuous and uncalled for, misrepresent him and render him vulnerable to ridicule. Already at least three publications have appeared that are based on the WILLIAMS-written twelve-volume set. The first was gotten out by Mrs. BURBANK—an abridged eight-volume set which did no harm, except as it put more of the misleading statements into circulation, as no new material was introduced. Another publication, *The Harvest of the Years,* was by WILBUR HALL, who had the advantage of several months' association with Mr. BURBANK and got much of his material first-hand. Unfortunately this author's knowledge of horticulture and plant breeding was distinctly primitive, so while he used some of the ghost-written matter, he had BURBANK at hand to interpret for him and very wisely refrained from using matter which he, and perhaps BURBANK too, knew to be spurious. The book is mostly made up of human interest things pertaining to BURBANK's life. This is far and away the best biography of BURBANK that has ever been written. With the author's complete lack of technical knowledge of BURBANK's work, he still did him no harm but at the same time did not improve his reputation in the world of science.

The latest BURBANK book by the same author (assisted by Mrs. BURBANK?), *Partner of Nature*[**], is a compendium or rehash of the famous twelve-volume set, and of course unfortunately tends to perpetuate the failings of that publication.

On the whole, I believe BURBANK's reputation is improving with time. I base this belief on the fact that scientists now speak of him more sympathetically than they did when he was living. I have sought the views of scientists in every state in this country and find them not only tolerant but kindly. With few exceptions the old rancor is gone. Controversial and unimportant issues appear to have been forgotten. Only essentials remain—that he was a pioneer in plant improvement, regardless of the fact that he has been misrepresented by those who would make a popular hero of him; that his name was sullied by venal promoters; fair-minded people still accord him a place in the scientists' Valhalla for his accomplishments in the field of plant-breeding.

[**] D. Appleton-Century Company, New York, 1939.

# VI

## BURBANK THE EGOIST

WE LEARN from BURBANK, himself, that as a child he was distressingly bashful and so timid that he would not appear at mealtime if a stranger was present. Because of this affliction he was often in hot water at school. On certain days every pupil was required to stand up and speak a piece, something memorized for the purpose. LUTHER was too self-conscious to do this. His suffering was so obvious that a sympathetic teacher allowed him to write a weekly essay in lieu of declaiming.

A further childhood handicap was the possession of a frail body which kept him from participating in the more boisterous sports. Left much to himself he was given to introspection; his thoughts soared beyond his environment. He knew that he was better informed than other boys of his age—that he read more, and perhaps listened more intently to discussions among his elders. His father, a native son of Massachusetts, was a man of varied interests—farmer, brick manufacturer, contractor for supplying pulpwood to paper mills—and always kept posted on current events, the kind of man that others liked to parley with, and consequently had many visitors. LUTHER liked nothing better than to "sit up" of winter evenings before a blazing log fire and listen to discussions on a wide variety of subjects: history, literature, politics, religion. Every new idea or proposition, whether national or local in nature, was turned over and over in spirited debate. Political, and especially theological questions, were discussed endlessly, often with warmth.

When LUTHER was about ten years of age the burning topic of the day was theological, had to do with the heretical pronouncements of CHARLES DARWIN in his *Origin of Species*. "The intellectual world was in a ferment," reminisced BURBANK some fifty years later, "and nowhere was the influence of the new ideas more quickly felt or tumultuously argued than in New England." This is only a sample of the tides of talk that ebbed and flowed about the BURBANK table and fireside. Young LUTHER was precocious and undoubtedly had a good opinion of himself, but there seems to be no evidence that he was looked upon as a conceited youth. Self-confident, yes, but extreme pride of accomplishment, with its concomitant of vanity, bordering on arrogance, came much later. However, it should be stressed that at no time was he aggressive in his arrogance, never inclined, without provocation, to press his opinions upon others. In his contacts with home folks, in lodge, and town meetings, I have not heard of a single instance of his setting himself up as an authority on questions at issue, or trying, arbitrarily,

to dominate a situation. To be sure, he was good at informal, round-table debate; but knowing his aversion to standing up before an audience, for any purpose, I doubt if he ever had much to say. Still, in the meetings he attended and in small crowds or at home, he could joke, tell stories and be lively. In fact, outside of his profession, BURBANK was rather famous for his bonhomie, was a man's man, but on the subject of what, to him, was his sacred destiny, and his ability and right to carry the torch of leadership, he was a stonewall of intolerance.

When BURBANK was about eighteen, in accordance with custom, he began to give considerable thought to his life work, to the profession he would like to follow. His state of health made farming seem too arduous. He tried employment in a wood-working factory but was soon incapacitated by the dust from his lathe. Entering Lancaster Academy, one of his courses of study was human physiology. This developed in him the ambition to become a physician, but he had to leave school and help in the support of his widowed mother. This brought him back to what probably was his first interest. He became a gardener, a grower of vegetables, for he had always loved plants. When he was twenty-three or twenty-four he drew a lucky number by developing a new potato. Other vegetables were hybridized with indifferent results but destiny was weaving the web that was to completely enmesh him after he had read what DARWIN had to say regarding the possibilities of modifying and improving plants through hybridization and selection. Plant improvement thus became the great ruling passion of his life. So sure was he that he could contribute untold benefits and values to the world that he looked upon his task as a foreordained mission, even envisioned himself as a Messiah. Unlike that other Messiah, the Jewish lad YESHUA, son of JOSEPH and MARY[57], who had required many years of prayer and meditation to decide whether he was the real Messiah—the one that had been promised by the prophets, —BURBANK was quite sure of his Messiahship almost from the beginning of his career in Santa Rosa.

As early as 1888 or 1889, he remarked to Dr. ANDERSON[58], of Santa Rosa, that the world had experienced many Christs—at least thirteen; that they assumed different forms and might continue to arise from time to time, and hinted that he, himself, he felt, was approaching that status. "This idea was only vaguely conveyed to me," said Dr. ANDERSON, "but to my mind, the implication was clear." He never elaborated on the theme and ANDERSON, being a very young man and an employee (he worked for BURBANK evenings, kept his accounts), refrained from asking questions. As a matter of fact, he was flabbergasted at the extraordinary statement. There was no doubt about it having been made in all seriousness and the situation was one that admitted of no argument.

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[57] SHALOM ASCH, The Nazarene. G. P. Putnam's Sons, New York, 1939.

[58] Personal conversation with the author, June 9, 1938.

When not busy BURBANK was sometimes talkative, and at such times inclined to reveal his inner self. It was on one of these occasions, mentioned elsewhere, that he compared himself to NAPOLEON. He frequently exulted at his growing recognition as evidenced by orders or inquiries from foreign countries. His mission was being fulfilled. This mission, it should be made clear, had nothing to do with spiritual leadership. It was wholly material in the sense that he felt he was destined to bring happiness and prosperity to the world through his plant creations. By this terminology he did not intend it to be understood that he possessed miraculous powers of creation, but he did want the public to feel that he was a superior workman with plants and could accomplish things by his methods that others could not achieve. And to a considerable extent this feeling was justified in that he began in the late eighties to offer for sale such an array of new varieties of fruits and flowers as to astonish the horticultural world and bring wonderment to the uninformed public which knew nothing about such things. It is not surprising that his accomplishments tended to stir the popular imagination and that space writers should take advantage of the opportunity to flood the press with exaggerated reports of his doings. As a matter of fact, the principles he employed were prosaic enough and well known to botanists and professional horticulturists, that is, the process of crossing varieties — thus commingling their characters — then selecting from the resultant seedlings those that are different, or in some respects better, than their parents. But others were not doing this, at least not on a scale large enough to secure noteworthy results, so he was unique and stood alone in his field.

Partly through good fortune but mostly due to shrewdness he started with Japanese plums. As no one had given much attention to this interesting fruit, which had great possibilities, his results were astonishing and spectacular. Even his direct importations, which anyone might have made, were a success, and his later hybridizations still more so, but again, others with less daring or business acumen, due to the inhibitions of custom, or what not, had failed to see the opportunities and improve them.

The zeal of the Apostles in spreading the gospel among the Romans was scarcely greater than BURBANK's ardor in his mission as he thought he saw his dreams coming true. Just as PETER and PAUL expected to see the whole world evangelized in short order, so did BURBANK feel that he was on the way toward bringing material comforts to a grateful populace. He was never lacking in appreciation of his own good points and, with the success that attended his early ventures, it is small wonder that he quickly developed the belief that it was possible to revolutionize the appearance and uses of all the plants of the earth — that they could be moulded to any degree, according to will, to meet the needs and wants of mankind for food, raiment, building materials and esthetic values.

In addition to his own convictions he had strong allies in his mother and sister. The mother had always believed in her son and admired his ability. She was in no sense a visionary and therefore had some misgivings about his program, perhaps thought or feared that it was a bit impractical. Never having known fame or fortune her aspirations were on a reasonable level. She was sympathetic but practical, and while gifted with a lively imagination she never allowed it to run riot. But not so sister EMMA. She worshipped her brother and believed in everything that he did — believed that he could accomplish all the things he dreamed of. So she encouraged him in all his plans and aspirations. Being unacquainted with the technique of his work — knowing nothing of horticulture and its problems — she was never beset with doubts as to his greatness. She was anxious for honors to be heaped upon him; and while wealth was not to be despised, honors and acclaim were more desirable. In season and out of season she sang his praises, wrote about him, kept all clippings for his scrapbook, talked to space writers and would-be interviewers, sought to protect him and his valuable time when he would have been absorbed by a curious and hero-worshipping public. A true friend and disciple, devoid of ulterior motives, she never let him down. Incessantly she fed his natural ego and cultivated the Messiahship idea. I have wondered that she did not revive the ancient order of *illuminati*, a sect whose members professed to have extraordinary knowledge or gifts, for he filled the bill perfectly.

Besides the members of his family — mother, sister, brothers — BURBANK had many personal friends who were devoted to him and believed in his infallibility. Judge LIEB of San Jose, California, was a typical example. The Judge was a follower but did not become a real disciple until BURBANK gave him a "sign", by successfully prejudging a batch of seedling fruit trees. Thereafter he had no doubts and was ready and willing to render full homage to his leader. LIEB's friendship was not only sincere, it was altruistic. Also he lived in the country, was a fruit grower and therefore possessed a technical knowledge of horticulture.

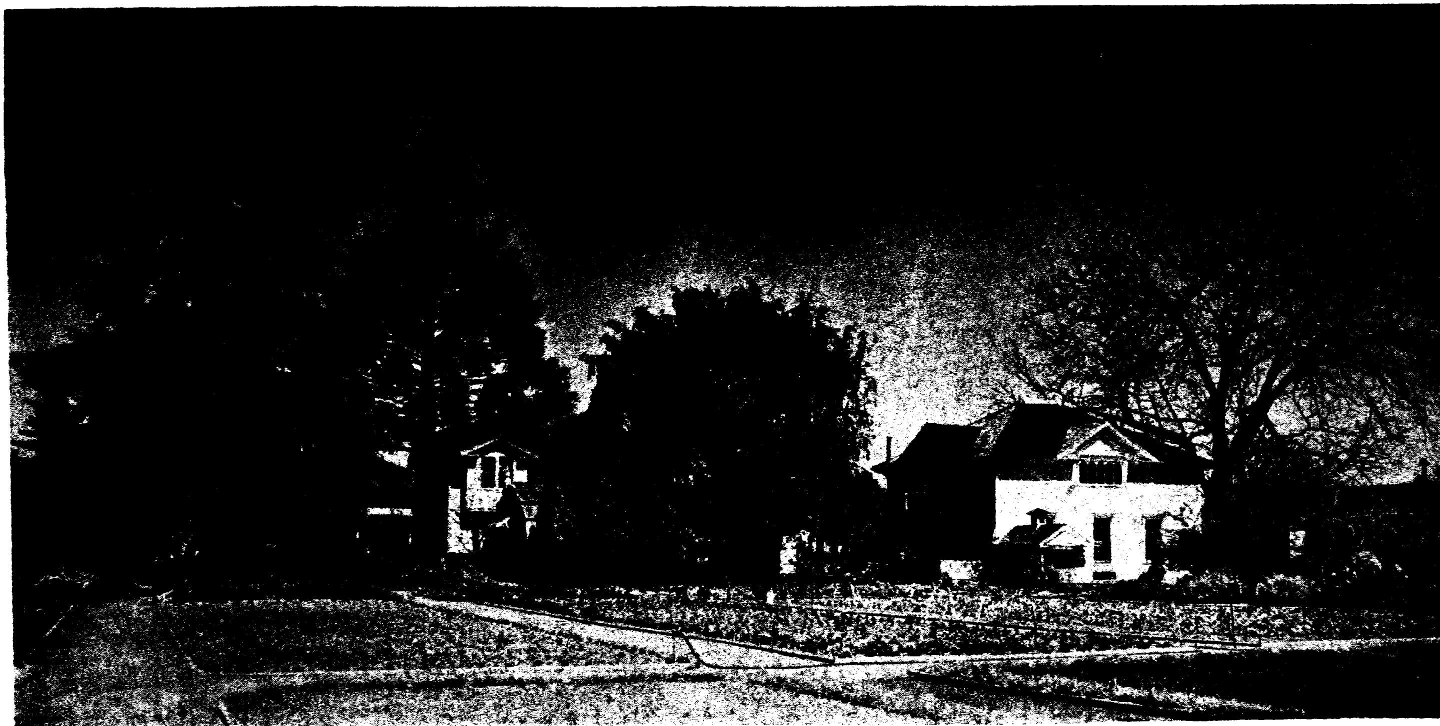
There were numerous other admirers who fall into various categories. Some were well-meaning but completely ignorant of his technology. Many were parlor naturalists and lovers of the wonderful in nature. There were garden enthusiasts and sentimental folk who wanted to do honor to the great, and they were all industrious in their acclaim of their idol. And, finally, there were the news writers and the dealers in BURBANK products whose accolades and paeans of praise were not without self-interest. Both of these groups were masters of publicity. Once as a matter of curiosity I asked a prominent editor and local correspondent of city papers, who as a young man had publicised BURBANK's doings, why he was such a great admirer of BURBANK. Since I knew them to be personal friends I expected him to enlarge upon the beauties of the man's character and the like but, without hesitation, he

replied, "Why I don't believe I ever called upon him that he did not give me a good story for my paper. He was certainly a wonderful man. Never was one like him before," and then launched into a denunciation of those who would minimize his genius and the institutions that failed to endorse and support him.

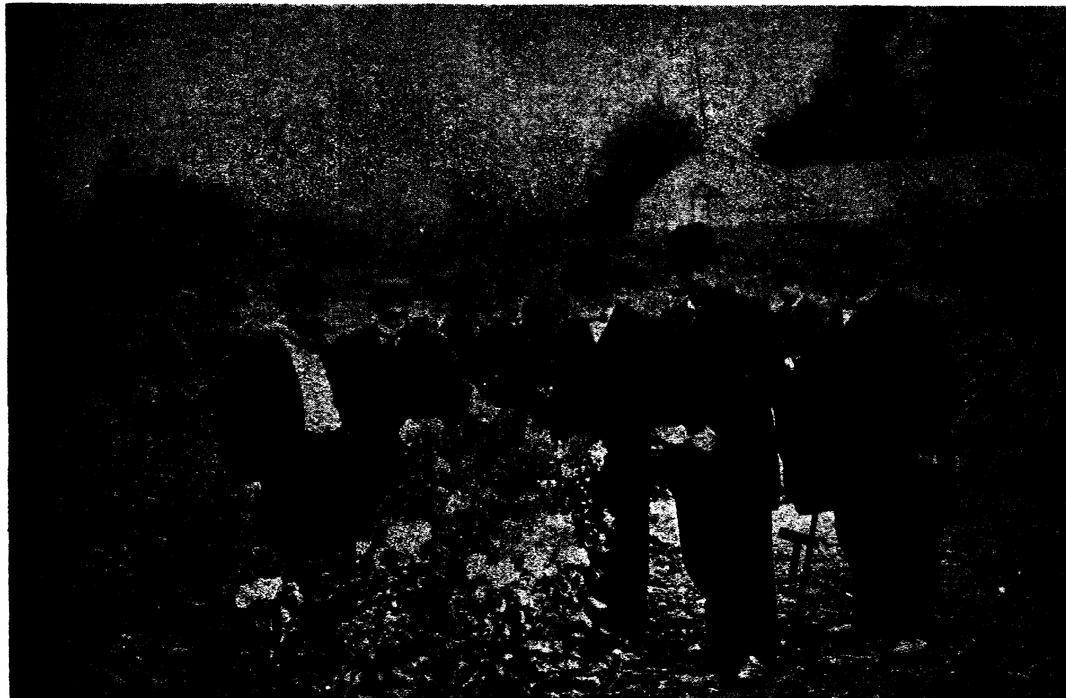
As to BURBANK's attitude toward the extravagant praise he received, he was something of a paradox. As stated elsewhere, he was personally modest and wanted to believe all the good things that were said about him. He believed them in the abstract, so to speak, but shrank from coming into personal contact with them. That is, he didn't mind being worshipped and reverenced at a distance but sought to dodge responsibility, in a measure, by refusing where possible to appear before crowds of people either in a public or a private capacity. Part of this reluctance to appear before crowds was due to a natural shyness. He knew that he was a famous man, and worthy of his fame, but he seemed to fear that he might not make good as a public performer. He might have had feelings of inferiority about his culture but certainly not on his attainments.

It cannot be said too often that he believed in himself and his mission. In his early middle life — say from about 1895 to 1905 or a little later — with all his ego I do not believe he would have permitted his counsellors to have used him as a stalking-horse to try to discredit the rediscoveries of Mendelism, by attempting to show that he, himself, independently, had discovered and demonstrated the laws of heredity as laid down by MENDEL before the announcements of CORRENS, DE VRIES and TSCHERMAK. After all, I believe he was honest and believed in a certain fitness of things. He didn't feel the need of being hoisted to fame in this way and besides he was no believer in Mendelism. But then, during the period mentioned, he had not yet fallen into the clutches of mendacious promoters who were determined to make their own kind of hero out of him. (See Chapter VIII).

By 1912 he was, for him, living in a totally new era, an era of big business but I am certain that he did not profit much, if any, by the schemes that revolved about him. All his life before, he had held to the theory of doing good for his fellow man and was not ambitious for great profit. I think, primarily, that he allowed himself to be drawn into the Luther Burbank Press and the Luther Burbank Society schemes for the publication of a popular history of his life work because the promised publicity pleased his ego and the information that he could make available would be of use to the world (for was he not to do the writing himself?). But he was now much older and a very tired and much harassed man, and there is no evidence to show that he resented the liberties the editors of the books took with what he had written and especially with the words that they put in his mouth. Before he was through with the task of dictating he was driven to the verge of nervous breakdown, and he was doubtless too tired to know or care what they



Rear view of the old home of LUTHER BURBANK in Santa Rosa, California, where he resided with his mother for nearly thirty years. At his own request he was buried beneath the sweeping branches of the beautiful Cedar of Lebanon tree at the left. His office was in a large room (now called the "Studio"), over the garage at the right, originally a stable for his horse. The tree at the extreme right is a Paradox hybrid walnut, a cross between the cultivated Persian or English walnut, *Juglans regia*, and the Northern California black walnut, *J. californica* var. *Hindsii*. (*Photograph by* Mr. ARTHUR E. GILMORE.)



Visitors in the Botanic Garden of the University of California at Berkeley, summer of 1904. Front row, right to left: Professor SVANTE ARRHENIUS, a Swedish chemist from the University of Stockholm; Professor HUGO DE VRIES, Dutch botanist from the University of Amsterdam, Holland; Dr. E. W. HILGARD, Dean of the College of Agriculture and Director of the Agricultural Experiment Station, University of California; Dr. JACQUES LOEB, Professor of Physiology, and E. J. WICKSON, Professor of Horticulture, both from the University of California. (*Courtesy of* MISS LESLEY C. WALKER, Oakland, California. Photographer unknown.)

made him say. This, combined with his disappointing experience with the Luther Burbank Company, marked the beginning of a distinct let-down in his ideals. (See Chapter XIII).

While he had been led astray from his life purpose and while his moral fibre had been weakened, his ego still survived and it may be that he derived a certain amount of vicarious pleasure in being compared to a man of the scientific stature of GREGOR MENDEL as well as the lesser luminaries, CORRENS, DE VRIES, and TSCHERMAK.

Secretly I don't think he was proud of the set of books which he had been led through Gethsemane to produce, as he was well aware of the questionable manner in which they had been financed and disseminated, but they did extend his fame to a certain audience to whom the contents were gospel; and they will remain as interesting documents for the wonderment of another age. The facts are that the books with all their beautiful color-photographs were almost ignored by the press. Here and there they were ridiculed on account of the shams practiced by the publishers in setting up a dummy Society to "help" in their production. I have scarcely seen anything in print about the books themselves.

While deep-seated and positive, BURBANK's egotism was not of the kind that grates on people. A man of firm convictions regarding his work and particularly his own values, he, nevertheless, could not be branded as arrogant or blatant. On occasion he could even be humble, but humility, I fear, was something of a pose. Toward casual visitors he was apt to be blunt in manner and dogmatic in statement, perhaps a cultivated mannerism designed to freeze them out and save his time. Toward his obvious worshipers he adopted a lofty attitude, was also dogmatic; and they loved it. In the presence of those whose good will he valued, he could be urbane, but even then he preferred to do most of the talking. To these, if they were known writers, he might stress his altruistic motives. But to all he appeared to assume that they came as votaries to the fountain of wisdom and that it was his duty to give and theirs to receive. His conviction was strong that he was a chosen one to do good in the world; then why shouldn't he have a good opinion of himself? Strangely enough, due to his personality, his air of confidence, his hearers were little disposed to challenge his statements or resent his vanities. On the whole, he might be rated as ego-altruistic, rather than egocentric.

## VII

## BURBANK THE MENTOR OF YOUTH

ALL his life BURBANK was a stanch friend of children, and, like many childless persons, held pronounced views on their bringing up, not in a disciplinary way, but for the good of their minds and bodies. As a first requisite he decreed that all children should be reared in the country, or at least under rural surroundings where they could have plenty of fresh, pure air and grassy playgrounds on which to romp and play. He considered it to be a short-sighted policy, if not criminal, to send very young children to school. He was certain that they should not be imprisoned in a schoolroom before they were ten years of age. They might even be older.

BURBANK's life was singularly free from the petty vices which society has come to accept in great or less degree, so he was a jewel of consistency and possessed no taint of hypocrisy when he preached to the youth of the land that they abstain from using tobacco or alcoholic drinks. He was particularly rabid against the use of tobacco; would not tolerate an employee who used it in any form; and once published a scathing article on the subject under the title "Tobacco, Tombstones and Profits"[60] in which he castigated the tobacco companies for undermining the health of a people for monetary profit. "Let me tell how tobacco kills," said he. "Smokers do not all drop dead around the cigar lighters in tobacco stores. They go away, and years later, die of something else. From the tobacco trust's point of view, that is one of the finest things about tobacco. The victims do not die on the premises, even when sold the worst cigars; they go away, and when they die, the doctors certify that they died of something else — pneumonia, heart disease, typhoid fever, or what not. In other words, tobacco kills indirectly and escapes the blame." He then continues in ironical vein, "I never met a tobacco user who did not regret that he had formed the habit, but I never met a non-smoker who was sorry he did not smoke. Isn't that significant? If tobacco is such a fine thing, why don't its victims rejoice? . . . Tobacco is a poison that would not be urged upon you if there were not a profit for others in making you a victim . . . . Youth is the dangerous age, as far as tobacco is concerned. If one can reach the age of twenty-five without smoking, the tobacco trust will have a hard time in getting him."

This was a favorite topic of his at teachers' meetings and at schools when he could be induced to talk. Because of his special

[60] Dearborn Independent, Dearborn, Michigan, July 21, 1923.

solicitude for the welfare of children, he rated tobacco as being a greater evil than liquor. This was during the early part of the prohibition era when he fondly believed that whiskey, in particular, was on its way out. Under other conditions — if he had not been wedded to his plant work — he might have become a militant reformer.

The biggest thing he did for youth was to launch a vigorous program for child and race improvement, by publishing an article entitled "The Training of the Human Plant",[60] which was later reprinted in pamphlet form[61]. While the ideas are his, the story bears evidence of having been ghost-written although some of the language is undoubtedly BURBANK's. Another version appeared about 1913 in Volume 12 of the LUTHER BURBANK series of books published by the Luther Burbank Press. Here the subject matter is overhauled and restated in the words of the editor, and, of course, BURBANK is made to discuss scientific findings in the field of eugenics which he probably was unfamiliar with.

In the original version of *Training of the Human Plant* the author says, "During the course of many years of investigation into the plant life of the world, creating new forms, modifying old ones, adapting others to new conditions, and blending still others, I have constantly been impressed with the similarity between the organization and development of plant and human life . . . . I have come to find in the crossing of species and in selection, wisely directed, a great and powerful instrument for the transformation of the vegetable kingdom along lines that lead constantly upward . . . . Upon it wisely directed and accompanied by a rigid selection of the best as well as rigid exclusion of the poorest, rests the hope of all progress. The mere crossing of species, unaccompanied by selection, wise supervision, intelligent care, and the utmost patience, is not likely to result in marked good, and may result in vast harm. Unorganized effort is often most vicious in its tendencies . . . .

"But when two different plants have been crossed, that is only the beginning. It is only one step, however important; the next great work lies beyond — the care, the nurture, the influence and surroundings, selection, the separation of the best from the poorest, all of which are embraced in the words I have used — selective environment . . . .

"We are more crossed than any other nation in the history of the world, and hence we meet the same results that are always seen in a much-crossed race of plants: all the worst as well as all the best qualities of each are brought out in their fullest intensities. Right here is where selective environment counts. When all the necessary crossing has been done, then comes the work of elimination, the work of refining, until we shall get an ultimate product that should be the finest race ever known. The best characteristics

[60] Century Magazine, May, 1906.
[61] Training of the Human Plant. The Century Company, New York, 1907.

of the many peoples that make up this nation will show in the composite: the finished product will be the race of the future. . . .

"In the immediate future, possibly within your life and mine, unquestionably within this generation, what we have most to fear . . . . is the children . . . . when they have grown and been trained to responsible age in vice and crime. We must begin now, today, the work of training these children . . . ."

He maintained that we must cut loose from all precedent and begin to give state and national aid in training the children of the poor and underprivileged in order that the integrity of the State may be maintained. "Rightly cultivated," he continues, "these children may be made a blessing to the race; trained in the wrong way, or neglected entirely, they will become a curse to the State. There is not a single desirable attribute which, lacking in a plant, may not be bred into it. Choose what improvement you wish in a flower, a fruit, or a tree, and by crossing, selection, cultivation, and persistence you can fix this desirable trait irrevocably. Pick out any trait you want in your child, granted that he is a normal child — be it honesty, fairness, purity, lovableness, industry, thrift, what not. By surrounding this child with sunshine from the sky and your own heart, by giving the closest communion with nature, by feeding this child well-balanced, nutritious food, by giving it all that is implied in healthful environmental influences, and by doing all in love, you can thus cultivate in the child and fix there for all its life all of these traits . . . . heredity will make itself felt first, and, as with the plant under improvement, there will be certain strong tendencies to reversion to former ancestral traits; but, in the main, with the normal child, you can give him all these traits by patiently, persistently, guiding him in these early formative years . . . .

"But, someone asks, what will you do with those who are abnormal? First, I must repeat that the end will not be reached at a bound. It will take years, centuries perhaps, to erect on this great foundation we have in America the structure which I believe is to be built. So we must begin today . . . . Shall we, as some have advocated, even from Spartan days, hold that weaklings should be destroyed? No. In cultivating plant life, while we destroy much that is unfit we are constantly on the lookout for what has been called the abnormal, that which springs apart in new lines . . . . No; it is the influence of cultivation, of selection, of surroundings, of environment, that makes the change from the abnormal to the normal. From the children we are led to call abnormal may come, under wise cultivation and training, splendid normal natures . . . .

"In child-rearing, environment is equally essential with heredity. Mind you, I do not say that heredity is of no consequence. It is the great factor, and often makes environment almost powerless . . . . environment [alone] will have a hard battle to effect a change in the child . . . . repeated application of modifying forces in succeeding generations will at last accomplish the desired object in the child as in the plant . . . .

"It would, if possible, be best absolutely to prohibit . . . . the marriage of the physically, mentally, and morally unfit . . . . first cousin marriages when they have been reared under similar environment should, no doubt, be prohibited."

He declared that there never has been such a thing as a predestined child, predestined for heaven or hell, although men have taught such things, and that total depravity never existed in a human being any more than it could exist in a plant.

"My own studies," said he, "have led me to be assured that heredity is only the sum of all past environment . . . . and I am assured of another fact; acquired characters *are* transmitted and — even further — that *all* characters which *are* transmitted have been acquired, not necessarily at once in a dynamic or visible form, but as an increasing latent force ready to appear as a tangible character when by long-continued natural or artificial repetition and specific tendency has become inherent, inbred, or 'fixed' as we call it . . . . Repetition is the best means of impressing any one point on the human understanding; it is also the means which we employ to train animals to do as we wish . . . . By repetition we fix any tendency, and the more times any unusual environment is repeated the more indelibly will the resultant tendencies be fixed in plant, animal, or man, until, if repeated often enough in any certain direction, the habits become so fixed and inherent in heredity that it will require many repetitions of an opposing nature to affect them."

The foregoing is a summary of BURBANK's philosophy of child improvement and race betterment. Idyllic and idealistic, a socialistic dream, but with human appeal, it is small wonder that the program received the endorsement of the pulpit and of humanistic writers. Some heralded it as the solution of the crime problem. The science of eugenics in 1906 had made little progress, birth control was not publicly advocated, and there had been no legislation designed to prevent the propagation of the unfit. However, about this time a forward-looking doctor,[a] only a few miles from Santa Rosa, began a daring experiment in eugenics which was destined to attract the attention and admiration of biologists and eugenist-minded people everywhere. People had talked about the advisability of curtailing the birth rate of undesirables but, for one reason or another, nothing much was being done in this direction until the physician in charge of the Sonoma State Home for the Feebleminded saw his opportunity. Among the inmates were many young women who had been committed to the institution for minor delinquencies and were to be held until they were deemed worthy of parole or discharge. For the most part these women — many of them young girls — were what is known as "incorrigibles," — that is, could not be managed by their parents or guardians.

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[a] BUTLER, Dr. F. O., Medical Director and Superintendent of the Sonoma State Home for the Feebleminded, Eldridge, California.

While the Sonoma Home is primarily a refuge for the feebleminded, both male and female, it is not the policy of the courts to commit persons to the institution simply because they are feebleminded, but only when they have become delinquent and the delinquency can be attributed to their mental handicap. All the inmates then may be classed definitely as sub-normal, the upper level being moronic and the lower approaching the outposts of imbecility. True idiots and the insane are supposed to be sent to one of the State Hospitals.

Men and women are committed to the Home for a variety of reasons but the majority would fall under the general headings of petty thievery, alcoholism, and sex offenses. Case history studies show much bad blood in their ancestries ranging all the way from epilepsy, criminality and insanity to downright degeneracy.

Clearly such people should not be permitted to propagate their kind to become a burden on society. To accomplish this end, there seemed to be only two possibilities: permanent confinement at state expense, or sterilization and release on parole. The latter plan was adopted and proved to be very successful. While the state law permitted sterilization of the feebleminded — forcibly if necessary — the policy has always been followed by the state institutions of securing, where possible, the written consent of the nearest relative as well as that of the patient. At first the women were reluctant to submit to the operation, even when assured that they would not be unfitted for marriage (except that they could never bear children), so the wily doctor had to resort to strategy to make his program effective. He contrived to have a few individuals sterilized and released, saw them married, and then arranged to have them re-visit the Home and tell their sisters how they had found happiness. Men were even more difficult than women to convert to the new eugenic measure, although in their case the operation was a very minor one, but by 1918 the coöperation of both groups was obtained and by 1940 a total of over 3,700 sterilizations had been performed,[63] a majority of them women. The success of the venture has inspired similar programs to be instituted elsewhere in this and other countries.

While BURBANK's paper had nothing to do with starting the Sonoma Home experiment, it is reasonable to suppose that it was made easier by reason of his having convinced many persons of the need for curtailing the propagation of the unfit, who otherwise, through sentiment, might have opposed the program.

At the time BURBANK published his paper on child improvement he possessed a powerful hold on the imagination of the reading public, who believed him to be a man of rare ability and accomplishment and therefore was ready to accept any theories he might advance for the betterment of the race. As has been seen, the burden of his argument was that plants could be improved by methods he had perfected and he was positive that the same prin-

[63] Personal letter from Dr. BUTLER, April 30, 1940.

ciples would apply to children. And there was enough truth in the examples he cited of the favorable effects of environmental conditions on both plants and humans to incline the readers — who had complete faith in him — to believe everything he said. He was a popular idol for everything that was good and uplifting. His audience, for the most part, consisted of these good people who are hard to reach through the cold facts of science. But they were willing to listen to BURBANK, and thus the way was smoothed — at least indirectly — for a radical experiment in race betterment that might otherwise have been frustrated before it really got started by well-meaning but obtuse sentimentalists.

When BURBANK espoused a cause he did so in deadly earnest. He believed in himself, and when he had ideas on a subject they were apt to be of a positive nature. He was never namby-pamby or wishy-washy. When he talked about race inprovement he meant improvement on a grand scale. To him it was sufficient to point the way to reforms; others might devise plans for carrying them out, for he never presented a specific plan of his own. The nearest he came to doing so is a statement attributed to him in Volume XII of *Luther Burbank, His Methods and Discoveries and their Practical Application*, page 216, where he purports to say, "We shall attempt no details of suggestion. It suffices to point out the principle and to suggest that there cannot well be two opinions as to the desirability of restricting the fecundity of the unfit, however wide the diversity of opinion as to the way in which this may be practically accomplished." Whether he or the editors wrote this it is impossible to say. With the Sonoma Home developments at his very door he might very well have hinted at sterilization of the unfit as being one answer to the problem — indeed, may so have expressed himself to the editors — as it is my understanding that he had to give his approval to all that was written before it was finally published.

BURBANK had a good general idea of the meaning of heredity — "the occurrence, in organisms, of qualities, expressed or latent, derived from their ancestors"[44] as applied to plants, but having no knowledge whatever of chromosomes and genes and their significance — at least in 1906 — he was inclined to underrate its importance and immutability and to overrate the forces of environment. This was especially true when, in his imagination, he applied the principles of breeding he was familiar with to the improvement of human-kind. It is probable that the human animal is comparable to plants only insofar as physical attributes are concerned. When psychic or mental traits are taken into consideration the comparison tends to break down. In other words, as a theoretical breeding problem, the improvement of people is much more complicated than is the improvement of plants.

BURBANK knew something about dominant and recessive characters, although he did not himself employ this terminology, and

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[44] **Journal of Heredity, February, 1937.**

the futility of trying to fix too many characters in a hybrid as a single objective; but he seemed to ignore all this experience with plants when he began to expound his theories about the betterment of people. Others had visualized an ideal state of society where there was no crime or immorality and no need of laws as described by PLATO over two thousand years ago, but BURBANK had the assurance to propose a plan for its realization here and now, but, unlike PLATO in his *Republic,* he did not face realities and go into details. It was just another dream by a man of spotless character, who loved children and his fellow-men and wished there might be a more perfect race to occupy a most beautiful world.

While sometimes naïve in his dealings with people he was not artless enough to really believe that his thesis for human betterment would be authoritatively adopted. He doubtless launched his thoughts as a sort of prayer that would give people something to think about. And it did. A certain part of the press commented favorably on the paper — some enthusiastically. They spoke of it as "suggestive" and "inspiring." It was well received by public school teachers and the clergy. Many personal letters were received commending him as a "student of life and philosophy of living things" and for his "interpretation of true heredity." [65]

The paper was an academic discussion of how the effects of bad ancestry, that is, heredity, may be ameliorated or completely overcome in human beings as well as in plants and domestic animals providing the child is taken in hand when still an infant. Whatever its merits as a scientific or social document, it enjoyed a rather wide circulation and, one way or another, received much favorable comment; and it is my belief that it served a distinct eugenic purpose by paving the way for Doctor BUTLER to carry out his famous program of "sterilization for human betterment" at the Sonoma State Home for the Feebleminded at a time when similar programs in other states had been stopped, by bringing pressure to bear on the Governor to veto the measure making it legally possible, as in Pennsylvania; by holding up appropriations to state institutions that permitted it, as in Indiana; or by stirring up adverse public opinion as in Washington, Oregon, New York, and other places. It appears to me that BURBANK had potent influence in stilling this opposition by his academic appeal for race improvement. The very fact that he did not enter into a discussion of ways and means of carrying out the program, and stir up controversy over details, was the secret of his influence.

[65] Testimonials published in his catalogs of 1919, 1921, 1923, 1924, 1925 and 1926.

## VIII

## BURBANK THE UNFORTUNATE

A FULL understanding of the events to be narrated in this chapter is all-important if BURBANK is to be fairly judged. I have, therefore, felt justified in going into them in some detail. Shortly after the turn of the century BURBANK's fame began to attract the attention of promoters. He was particularly vulnerable to their siren songs because he was finding it increasingly difficult to spare the time from his experimental work to market his productions. And they had to be sold to keep the business going. This was the situation that promoters took advantage of. Within a period of three years, 1912-1915, he had the misfortune to have his name associated with two gigantic enterprises that failed disastrously, and he barely escaped entanglement with another.

The two concerns that failed were the Luther Burbank Press, a book publishing business, and the Luther Burbank Company, which was organized to sell BURBANK's plant products. Both engaged in farflung activities. Their contacts numbered well over a million people and when they collapsed BURBANK's reputation suffered greatly because the public believed, on account of the names they bore, that they were his creatures.

As a matter of fact, and in all fairness, it should be understood that he was culpable only insofar as he had lent his name to the enterprises. Apparently, he owned no stock in either of them and had no part in their management, except that, in the case of the Company, he reserved the right to veto the appointment of members of the board of directors who did not meet his approval. In the book publishing scheme, he did dictate the material on which the volumes were based but the twelve volumes were actually written by high-powered editors employed by the concern for the purpose. He may have received a part of the flat sum promised him for his factual contributions and something on royalties, but he had absolutely nothing to do with soliciting subscriptions or selling stock in the Burbank Press.

Likewise he had nothing to do with the stock selling or merchandizing methods of either of the corporations, but in the popular mind he was, and is, held accountable for every statement made in their dealings with their tens — perhaps hundreds — of thousands of customers. One purpose of this book is to rescue his name and reputation from the obloquy suffered through his remote connection with the two enterprises.

The first scheme that was launched, the one that did not mature, was in 1909. Two men from San Francisco, HERBERT and

HARTLAND LAW, who had made a fortune in patent medicines,[66] together with OSCAR BINNER, a professional promoter, induced him to sign a contract agreeing to let them market everything he produced. A sales manager[67] was engaged and entered upon his duties at the BURBANK place in Santa Rosa. At the end of three months, while a corporation known as the "Luther Burbank Products, Inc." was being perfected, BURBANK suddenly decided that he didn't like to have other men around him with authority to give orders and so refused to go through with the plans. He stated in explanation,[68] "As no corporation has yet been formed and only a preliminary contract executed, when the proposition was found to be impracticable, it was mutually agreed that it be abandoned" and a representative of the company, Mr. BINNER, added the further statement: "For myself and my associates, the LAW Brothers, let me say that Mr. BURBANK's absolute happiness and contentment are our first consideration. . . . We were willing to step aside and annul the contract we entered into together on the 23rd of February." BURBANK agreed to keep the unlucky sales manager in his employ till he could find another job. So the incident was closed.

Three years later a representative of the Cree Publishing Company[69] of Minneapolis, Minnesota, organized the Luther Burbank Press with ROBERT JOHN as president of the firm. The aim of the enterprise was to exploit the BURBANK name by publishing a monumental history of the man and his work, to be written by BURBANK himself, with Rev. Dr. MAYO MARTIN as Editor. With a battery of helpers, MARTIN set up shop in the old BURBANK cottage while the BURBANK family moved to a new residence across the street. The editor struggled with the job for five or six years but progress was unsatisfactory. Apparently there was a reorganization, JOHN WHITSON replacing the Cree Publishing Company. The new firm was called the Luther Burbank Press. Preparation of a BURBANK history was still the big idea.

The promoters were men of lively imagination. From the beginning everything was planned on a grand scale. The essential advertising of BURBANK had already been done, for he had been publicized as few men have been during their lifetime. He had a legion of followers whose admiration was based on sentiment, and his name already was becoming a legend. The time seemed to be ripe for cashing-in on his popularity.

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[66] Pacific Rural Press, San Francisco, California, March 6, 1909 " . . . . The brothers LAW are princes at publicity promotion. They made their wealth according to popular report by handling proprietary medicinal preparations in novel and effective ways, and such business has almost become a synonym for successful advertising and other promotive pushing among patrons who are disposed to enjoy high claims and content to verify them in their personal experiences. . . . ."

[67] W. B. CLARKE, now a nurseryman at San Jose, California.

[68] Santa Rosa Press-Democrat, Santa Rosa, California, March 26, 1909.

[69] Santa Rosa Press-Democrat, January 10, February 21 and 23, 1907. DUGAL CREE, President of the Cree Publishing Company, arranged with BURBANK in September, 1908, for the publication of a 10-volume work to be entitled, "New Creations".

It is doubtful if BURBANK undertook the job wholly for profit. He had not previously shown a craving for wealth at the expense of sacrificing much of his professional career, for it cannot be emphasized too often that he sincerely felt called upon to perform a great work, a vital service to humanity. His mission was to breed more and more plant forms that were to be better and more useful than their predecessors. As a one-man institution, he had constantly to fight for time to do those things that he would entrust to no one else. This was the reason that he so nearly succumbed to the sales talk of the LAW Brothers and OSCAR BINNER three years earlier. Still he was willing to go on with the rejuvenated publishing scheme in spite of the time it would take. Presumably the old contract was yet in effect and had to be fulfilled or he may have had other reasons. (See Chapter XIII).

Apparently he was to have been paid $30,000 in cash and a royalty on books sold. However, his money reward was disappointing, a small down payment being about all he, personally, ever received. He retained possession of the copyright on the set of books and profited to some extent through issuing an abridged edition and finally, in 1939, long after his death his estate allowed the material to be boiled down to a single volume.[70]

The management of the Burbank Press[71] concocted a shrewd scheme for capitalizing the BURBANK name, at once obtaining a personal following, and laying the groundwork for selling their securities. They organized, or rather proclaimed, the existence of a so-called Luther Burbank Society,[72] and declared the membership was to be limited to 500 names, with the first hundred to be designated as charter members.

I, myself, as a young instructor in horticulture at the University of Missouri, received one of these invitations to become a charter member at a cost of one dollar. In return the publishers agreed to send proofsheets of the forthcoming book, "LUTHER BURBANK, His Methods and Discoveries and Their Practical Application," which they would ask the members to criticize and help edit. There were to be ten volumes and as rapidly as they were published they were to be sent to the distinguished list of subscribers who agreed to pay for them at a cost of fifteen dollars each — a total outlay of $151 including the membership fee.

My own invitation stressed the importance of quick acceptance as it was pointed out that only a few of the most important people of the United States were being invited and that I had the honor of being one of the number. To emphasize this point the invitations bore serial numbers. Mine was somewhere in the seventies. With the feeling that an obscure instructor had been mis-catalogued, I

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[70] Partner of Nature. Edited and transcribed by WILBUR HALL, D. Appleton-Century Company, New York, 1939.

[71] Incorporated under the laws of the State of Maine on May 23, 1912. Charter to do business in California forfeited for non-payment of taxes on March 12, 1916.

[72] Incorporated April 3, 1912. Document on file in the office of the County Clerk of Sonoma County, California, in Santa Rosa.

dropped the invitation in the waste basket. In a month or two a second invitation came along, this time bearing a much lower number — thirty-five or forty or thereabouts. This went the way of the first.

About this time many of BURBANK's friends were becoming more and more apprehensive of the way his name was being exploited, as one of them stated, "to the point where the substantial reputation gained by his worthy achievements is being rapidly lost through the unworthy methods employed by organizations either affiliated with Mr. BURBANK himself or using his name with authority. . . . There is more than a suspicion that he has been exploited to his detriment by some of those he has trusted . . . ." Many schemes had been launched for selling spineless cactus, some with authority and some without. At best, extravagant claims were made but unauthorized wild-catters, aided and abetted by irresponsible space writers, suggested and even promised absurd and impossible things. BURBANK protested, ineffectually, through the medium of his own publications — catalogs and price lists — but the current of misstatement was too strong for him to struggle against. It may be that he recognized that he, himself, had set the pace.

A characteristic of BURBANK was that he did not bestow his confidence easily, but once a person could break through his protecting shell of self-sufficiency by making the proper appeal to his ego or cupidity, he seemed to accept that person and trust him implicitly. To trust a person, with him, was to ignore all criticism as he ignored it toward himself. Not given to seeking advice, he was apt to be suspicious of those who tendered it. While gratefully accepting the plaudits of his admirers, he had found by experience that they could go too far and subject him to ridicule. Therefore, he was inclined to be mistrustful of many of his would-be friends.

I have no evidence that BURBANK gave any serious thought or attention to the doings of the Luther Burbank Press or its spawn, the so-called Luther Burbank Society. He must have been cognizant of the methods being employed but he was absorbed in his own affairs and chose to ignore them, as he did on other occasions, thus employing a sort of split personality, although in general I would not class him as a schizophrenic, for that is too near dementia; and he certainly was not mentally unbalanced.

The agricultural press of California was friendly toward BURBANK and believed in him but in 1913 editors began to speak out in no uncertain terms because they felt his reputation was being injured. The following is a representative sample of what was being said, as quoted from the *Southwestern Stockman, Farmer and Feeder*:[n] " . . . The Luther Burbank Society has been conducting a campaign for funds and membership throughout the United States for a number of months in a manner which has placed Mr. BURBANK in a very equivocal position and has as a matter of fact made

[n] California Fruit Grower, Los Angeles, California, October 25, 1913.

his name largely a joke throughout the country. Mr. BURBANK has had his attention called to this matter, but the methods used by the Luther Burbank Society continue to grow more outrageous rather than to show any improvements. When it is stated that but one hundred or so 'noted personages' are wanted to form the society and when one finds that every person whom one has heard of in almost any part of the United States has been included in the invitation to become one of the 'noted personages' in the society within the limits of a hundred or two — without going into any further details, it certainly is clear that something is wrong, and it is a shame that anything of this kind should have become connected with the name of LUTHER BURBANK."

Although the membership scheme was in the nature of a hoax, those who signed up received their books as promised but they had no chance to edit the text in any form. Six years later I purchased a full set of the books — not ten but twelve volumes — from a Chicago department store for $17.00.

The last phase of the Company's activity consisted of plans for publishing several editions of an eight-volume set of books (essentially the same as the twelve-volume set but more condensed), which had to be financed by a huge bond issue. Full-page advertisements began to appear in the leading local newspaper,[4] and continued at intervals for the next three years. The first offered "the unsubscribed portion of $80,000 Luther Burbank Press, 7 per cent five-year compound notes. Free of taxes. . . . Interest payable . . . . every six months. . . . Subscription period closes Saturday, November 9, 1912. All applications sent on or before that date will receive a bonus of 25 per cent in stock. . . . . The total authorized issue of these notes is $300,000. More than $100,000 has already been subscribed. Only $80,000 of the balance is available for subscription in Sonoma County. . . . ." As a morale-builder it was explained that "The Company known as the 'Luther Burbank Press' was originally set up by a group of prominent people from all over the United States who subscribed a total of $600,000 worth of stock — fully paid up [claimed to be], $480,000 preferred and $120,000 common. . . ."

The advertisements were craftily worded so as to make a special appeal to local people. Their pride was touched by such statements as, "It is the biggest business undertaking of its kind not only in Santa Rosa but anywhere west of New York and will turn over several million dollars a year at a profit of nearly half the turnover. . . . The Company's securities have not been offered to the general public heretofore, and the present offer is confined to Sonoma County for special reasons, namely: the company will need the cooperation of Sonoma County residents in securing larger postal facilities from the Post Office Department, in petitioning the Interstate Commerce Commission for more equitable freight and

[4] Santa Rosa Press-Democrat, Nov. 3, 1912, Nov. 2, 1913, Mar. 7, 1914. Jan. 12, 1915.

express rates (since, when the delivery of the books commences, the company's freight and express bills will exceed $100,000 a year), in securing from the Department of Agriculture unpublished or private statistics or information, and from the Panama Pacific Exposition [soon to be held in San Francisco] better than ordinary concessions.

"Further, the company has been strongly advised by its bankers and counsel to make this offer on the ground that local influence is best secured by making it possible for local residents to have a share in the profits originating from a local enterprise of this magnitude and exclusiveness."

A year later pictures were shown of the busy offices and mailing room. Postal receipts were so heavy that the local post office had to be reclassed, upward, more than once. They were very proud of their "efficiency" system of advertising the Luther Burbank Society, as well as their methods of selling stock and taking orders for the books. This was a mail order business exclusively. Apparently it was the twelve-volume, $181.00 edition, that was being sold. The eight-volume set came later, and the five fantastic special editions were to come along still later. It was claimed their card index files contained more than a million addresses of prospective customers. The advertisements related how two of the high officials of the company had been brought from the east where they had been in charge of enterprises that ran into the millions — that they were go-getters and no mistake, and concluded with the slightly apologetic statement — for Santa Rosans — that, "Although it [the company] now maintains offices in San Francisco, Chicago, and New York, the Santa Rosa office is, and will continue to be, the principal place of business. . . ." All of which was very impressive and, in the language of the popular song, "My God how the money rolled in."

In a supplementary broadside issued the same year chiefly, but not exclusively, addressed to local investors, the writer of the advertising copy — presumably Mr. JOHNS, the moving spirit of the enterprise — really let himself go as he told about plans for the publication of additional sets of books and the phenomenal profits that might be expected to follow. Five editions were projected. In reality, four of them were to be identical in subject matter with the eight-volume set previously referred to but dressed out in different bindings and designed to serve special purposes. In the statement that follows it will be noticed that one set was to be made up of government and state agricultural bulletins, literature that had always been free to all for the asking, but the promoters were sure people would buy it readily if in some way it could be associated with BURBANK's name.

It was also glibly assumed that the public schools, colleges and universities would want the BURBANK books and other miscellany for teaching purposes, an assumption that was truly a masterpiece of absurdity. That these gems of optimism may not be lost, I quote them in full:

"1. Popular edition in 8 volumes to be sold to 7,000,000 farmers and 4,000,000 rural and suburban people — 50,000 sets at a net profit of $10 a set.

"2. The text book edition, consisting of a series of 8 books, 2 for primary, 2 for grammar, 2 for high school, and 2 for college grades — 17,000,000 copies annually, $1,200,000 at a profit of $200,000.

"3. Special reinforced library edition, 8 volumes, same as popular edition except bound especially strong for frequent handling — 15,000 copies. The Burbank books are a necessity to the libraries and their entire demand can be supplied within two years at a profit of $300,000.

"4. The special Monograph Edition, consisting of a series of approximately 3,000 bound bulletins and booklets to sell at 10 to 50 cents, each dealing with one specific subject, to solve the soil tiller's specific problems and to give him precise information on specific subjects, the information to be collected from reports of the United States Department of Agriculture and of the various states. An estimated business of $250,000 a year can be developed at a profit of about $50,000 a year.

"5. Foreign edition, of 8 volumes, same as American Popular Edition but translated into French, German, Italian, Spanish, Japanese, and Russian, and adapted for sale in England, Australia, South Africa, and Canada. Total market as great as for the United States."

At no time have I been able to find any editorial comment, either in approval or disapproval, in any of the newspapers of Santa Rosa or the environs where stock sales were heaviest. Apparently the community was stunned at the unheard-of developments in its midst and simply waited with baited breath for the golden showers to begin descending upon them.

A final announcement was made in January, 1915, to the effect that the 12-volume set of BURBANK's work was complete, after three years of work and the expenditure of $400,000. Also that the headquarters of the sales organization was being moved to New York City and that agencies would be established in a number of large cities. How many sets of books were published, and what Santa Rosans thought about the removal of the head office from their town, is not indicated in the public records of the day. Subscribers had now received their copies of the 12-volume set and apparently plans were far advanced for issuing the condensed 8-volume set, but I am under the impression that it was actually finished and put out by BURBANK and his own helpers as a part of his salvage after the corporation failed.

The early part of 1915 seems to have marked the high point in the affairs of the Luther Burbank Press and thereafter they went into rapid decline. Complete collapse came within a few months. Presumably the stockholders lost their entire investment. Very naturally they were bitter on account of their losses, but oddly enough, taking the country as a whole, BURBANK's personal reputa-

tion suffered less from the stock selling schemes than it did from having his name associated with the phony Luther Burbank Society. The first was a business affair only, the second was more than that; it involved sentiment. There probably were many more of the latter, too, despite the alleged 500 limit to the membership, and they were far more widely distributed. When they discovered they had been used to further a larger scheme their emotional reactions ranged from embarrassment to disgust; they felt they had been duped by one they had trusted, because to them, the "Society" was a personal attribute of BURBANK himself. They were proud of their membership: for was it not stated in black and white, in the literature they had received, that they had been singled out to become honorary partners of the great man and would be asked to advise him when he began writing his books?

That these "memberships" were highly valued is well illustrated by a personal experience at the Panama Pacific Exposition in San Francisco in 1915. The horticultural section of the Jury of Awards found itself in need of an authority on apple varieties of the eastern United States. I suggested GEORGE T. TIPPIN, a Missouri fruit grower, and he was appointed. When he reported for duty at the jury room — being a stranger — attendants questioned his right to enter. He was arguing the case when I arrived, just in time to hear his concluding statement, made with great dignity and intended to be crushing: " . . . . and I am a member of your own Luther Burbank Society." The situation was delicate. I contrived to advise him not to parade his "nearness" to BURBANK. He didn't like this but consented when told that none of the rest of us had been honored with "memberships." Later, with full information, he was crestfallen, saw his dreams of prestige fading away, was an unhappy man. He even lost his desire to visit the BURBANK place, which had been his dearest wish when he left home. It was no use to remind him that BURBANK had not planned or organized the "Society," had practically nothing to do with it, and should not be blamed for everything. But he would have none of it. He said he had been deceived by somebody and thought BURBANK was the man to hold responsible for the deception, which, I believe, was typical of many others. So far as I can learn BURBANK never made the least effort to clear himself of charges of this kind.

The Luther Burbank Company (the firm that was to sell his fruits, flowers, etc.) was the second concern that failed and cast aspersions on BURBANK's name. This was another scheme that grew up like a mushroom after a warm rain. Whereas the Press was operated on a national scale, the Company was international in its scope. The first was a manufacturing concern while the second was strictly a sales organization. Both sold stock extensively and in both cases the stockholders lost their money.

The chief promoter of the Luther Burbank Company was one ROLLO J. HOUGH, a minor official of an Oakland bank. HOUGH gave the impression of being a man who was "stepping out" after a period of enforced suppression of his talents in a sedate banking

institution. Self-confident and optimistic by nature, he threw himself into the new enterprise with a bounding enthusiasm that was matched only by his driving energy. Undeterred by the fact that he had no personal knowledge of the seed and nursery business, he evidently felt that talent of this kind could be hired when needed.

Public psychology was at the right pitch for commercializing BURBANK's productions, that is, for interesting capital in such a selling scheme. His fame was so great that many believed, and others were easily convinced, that his products would sell themselves — that it was only a matter of setting up the necessary operating machinery to place them in the hands of the customer and gather in the money; that the customer would be satisfied with what he got and would want more and more was taken for granted. It was only a question of merchandizing, like selling bricks or nails which everybody wanted in unlimited quantities, with only one man possessing the secret of their manufacture.

This was the situation in 1912 when BURBANK was at the peak of his renown — when his name was a byword in a dozen languages — and explains the state of the public mind that made possible the organizing of the huge selling concern involving the investment of hundreds of thousands of dollars.

It might be expected that men of experience in managing banks and corporations would not be swayed by sentiment or mass hysteria but here they were with their money in their hands ready to back their favorite. If the names on the first board of directors [75] of the new company was a fair sample of the other purchasers of stock, the investment must indeed have appeared attractive alike to bankers, merchants, capitalists, investment brokers, doctors, and lawyers. With two great universities near by one may wonder why there was no representative of that supposedly most gullible of all groups — the college professor — for there were a few BURBANK enthusiasts both at Stanford and California. One answer is that as a class they were unresponsive to the BURBANK appeal, and another is that they probably didn't have the money.

I want to make it clear that while there may have been stock juggling as charged [76] when the Company was breaking up three years later, the great majority of the stock purchasers put up their money and held on to their stock because of an abiding faith in BURBANK's products, which, in a final analysis, meant a child-like faith in the man himself. And, I repeat, that BURBANK at this time certainly believed in his own productions. Many of his fruits and some of his flowers had made good in a big way and his state of mind would not allow him to doubt the value of the others that had not yet been tried by time, and the stockholders accepted everything at his own estimate.

In his dealings with the Company BURBANK had the benefit of excellent legal advice. When in need of the services of an attorney-at-law it was his policy to employ the best talent available and the

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[75] **Santa Rosa Press-Democrat, Santa Rosa, California, December 3, 1912.**

[76] **Santa Rosa Press-Democrat, Santa Rosa, California.**

vicissitudes of his business had occasionally made it necessary to have such help: to stand by him when he repudiated the agreement with the LAW Brothers, to write contracts with the big seed companies he transacted business with, to prosecute an express company for the loss of a ten thousand dollar shipment of cactus to Australia — to mention a few representative cases. While he madè use of local talent on occasion, his more serious business affairs were entrusted to Attorney F. S. WYTHE of San Francisco. The demands on his time by the minutiae of business irked him sorely and he evaded as much of it as possible to the despair of his office help. But when it came to entering upon a basic contract that involved a big sale he ran true to his native heritage, for at heart he was a shrewd trader and could drive a hard bargain.

Because BURBANK was a romantic character and because his eccentricities and seemingly careless business habits had received considerable publicity, he gained the reputation of being an "innocent" and a potential "easy mark." People of meticulous business habits could reach no other conclusion. All of which must have caused him many an amused chuckle for, to a certain extent, I believe he really enjoyed the glamor of this devil-may-care reputation that had been pinned upon him. In a way it was an asset when he came to sell something — to appear innocent. At this time he was in a position to control the price of his wares because he had no real competitors. He was selling his own things and the public believed that no one else had anything as good.

Experienced seedsmen and nurserymen, who knew the comparative values of flowers and fruits, naturally were in a position to indulge in a certain amount of haggling over prices, although even they always were fearful that something might turn out to be of unusual value and that it might fall into the hands of a competitor, and so were impelled to snap it up without too much argument.

But now comes along a bunch of capitalists with ample means who wish to purchase all his present, past and future productions and will pay in cash or with seemingly good promissory notes and will take everything at his own valuation. Such a thing has not happened before — the proposition seems too good to be true. Yet, there it is; the offer is bonafide; there is no question about that; his attorney can find nothing the matter with it — his terms have been accepted, payment appears certain, all his troubles are over, he is at last a free man with security and time for pursuing his experiments; all vexations and worries removed from his life, so he signs the agreement.

But BURBANK has a big bump of caution — there may be a nigger in the woodpile somewhere — so he tries to make assurance doubly sure by providing that he is to name the president of the Company and have his attorney madè a director and through him approve the other members of the directorate.

The Luther Burbank Company was incorporated in California by ROLLO J. HOUGH and W. GARNER SMITH on April 22, 1912, but

the organization was not completed until the following November. In the meantime, a corporation called the Universal Distributing Company was set up to receive such things as BURBANK was ready to release and to establish nurseries and seed farms for multiplying them, for it must be remembered that BURBANK never had more than small stocks of new things on hand and it would require from one to three years to increase them in quantities sufficient for selling at wholesale. And this is where some of the troubles began that were later to rise up and plague the management. Even though they may have been inexperienced in conducting a nursery and seed business they did recognize this. In their first general catalog,[77] bearing the date of 1914, they say, "naturally, years must elapse before sufficient quantities of seeds of certain varieties can be obtained for general distribution. . . . When BURBANK completes a new creation he delivers it in the form of a few ounces of seed or a few feet of grafting wood, as the case may be, to the propagational department of the Luther Burbank Company. Sufficient quantities are then produced for introduction to the world at large."

In their initial announcement seeds were their first offering; no fruits except two blackberries and a strawberry. There were also two or three dozen kinds of bulbous plants and a couple of roses — all things that had been offered by BURBANK in previous years. Then followed about 30 pages of standard seeds consisting of flowers and vegetables and a list of more or less well-known roses that were popular at the time.

The Company thus went into the general seed business at once but at the same time handled over a hundred different kinds of seeds and bulbs advertised as BURBANK productions, although all but a very few of them had been offered before by BURBANK himself and presumably he had small stocks of each on hand to turn over to the Company. Apparently the Company did not offer anything for sale the first year, 1913, except cactus — at least I have not been able to find any advertising literature covering that period, aside from the pamphlet on cactus. Presumably all the BURBANK things were being propagated as rapidly as possible. Even so it seems incredible that a sufficient stock could have been accumulated in so short a time to properly fill the flood of orders that must have been received as a result of the intensive advertising campaign that was being carried on and which had been going on for the past 12 or 14 months.

There was much complaint from customers who felt that the goods they purchased were not as represented. Some carried their complaints and suspicions to the newspapers, but the greater number suffered in silence or made sarcastic remarks to their intimates. This latter group was widely distributed and because, in the aggregate, the number of individuals was great, a legion of people heard that LUTHER BURBANK was guilty of sharp practices and in too

[77] BURBANK Seed Book, pp. 7 and 8, 1914.

many instances that view was passed down to the present generation. Not one per cent of the hundreds and hundreds of people I have contacted knew that the Company was separate from BURBANK. Those that had some inkling of the existence of a company thought that it was organized by BURBANK and that its policies and practices were dictated by him.

Owing to the disclaimers[78] included in their catalogs, (the usual practice of vendors of seeds and plants) it was exceedingly difficult to secure redress from the Company. If willful misrepresentation could be established, such as selling a seed or plant of common origin as a BURBANK production, then a judgment in court might be secured awarding something beyond compensatory damages.

When ROLLO HOUGH was promoting the Company he approached GARNER SMITH, a young insurance man and stock broker of San Francisco, who became so enthused with the plans that he invested a small fortune in the venture. Being a salesman by profession SMITH became a valuable man in the organization and was selected as its secretary-treasurer. JAMES F. EDWARDS of Santa Rosa was president. It was young SMITH who had the foresight to establish seed farms and nurseries to multiply BURBANK's novelties which were taken over in small quantities. He later acted as a salesman for such things as the Company had ready for placing upon the market.

At the time SMITH associated himself with the Company, he had great faith in the things put out by BURBANK, so much so that as a matter of pride he made up a collection containing every novelty that BURBANK could deliver and sent it to his father to be planted on the latter's farm in Kentucky. The collection occupied an area of six acres. SMITH Senior planted everything with care — fruits, flowers, grains, cactus, and so on, but scarcely anything proved to be of any value. This was disappointing — even humiliating — to young SMITH, and his faith in BURBANK as a producer of wonders in plant life dropped to a low level.

During the year 1913 the income from sales was small, possibly because there was little to sell outside of standard articles that could be secured from any seed house. At this time there was dissension within the management regarding matters of policy. Some thought a vigorous sales campaign should be instituted, while others opposed the plan. It was becoming apparent that something was radically wrong. First of all it was evident that such things as had been sold as BURBANK novelties had not made good, and there was much complaint and few repeat orders were received.

Early in January, 1914, in the face of this situation, GARNER SMITH took the road as a salesman for the Company. He visited

[78] "We guarantee the seeds, plants or trees sold by this Company true to name and will replace any that may prove otherwise through a possible error, or will refund original purchase price. Our liability upon any article sold is limited to the original purchase price, and all sales are made with this understanding." BURBANK Seed Book, page 77, 1914.

the principal cities in the eastern and middle states. In three months, although the usual buying season was long past, he was able to book orders amounting to thousands of dollars, especially from establishments like department stores. As evidence of the growing lack of harmony in the Company, most of the orders were turned down by the Manager who had decided to raise prices.

SMITH returned from his trip with definite ideas regarding policies to be pursued if the Company was to make a place for itself in the highly specialized seed business. It being clear that steady customers could not be expected for BURBANK's novelties, the next best thing seemed to be to go fully into the business of growing and selling of standard seeds after they had been thoroughly tested and found to be dependable. He believed that a combination of the very best seeds that could be grown, together with the prestige of the BURBANK name, would be an unqualified success. This plan was not approved.

One of the biggest mistakes of HOUGH, the Manager, was his refusal to see the necessity of employing skilled help to oversee the growing of seeds to keep them true to name and type. For example, GARNER SMITH [99] recalls an instance on one of the Company seed farms where two varieties of seed corn were being grown side by side where they would be certain to contaminate each other. To be sure, knowledge of scientific plant breeding was scant in 1913 but enough was known, and in the hands of practical people, to have made it possible to grow pure seeds. Indeed, most farmers and gardeners knew that to be kept pure a variety of seed corn or seed melon must be kept isolated from its kind to prevent mixing through cross-pollination. But the Manager and his field helpers did not appear to know that this was important or did not care.

Irreconcilable differences on questions of management became so acute that SMITH resigned on April 25, 1914. President EDWARDS, too, had resigned a short time earlier. Both men made the mistake of not demanding that their stock be taken off their hands, and both lost their entire investment which, combined, amounted to well over one hundred thousand dollars.

At first in 1913 or early 1914, dividends as high as twelve per cent were paid to stockholders as a result of heavy sales of cactus, but in the spring of 1914 financial difficulties began to be felt and dividends quickly dropped to six per cent and later ceased entirely, and nothing was paid thereafter.

During the latter half of the year 1914, money troubles became so real that the semi-annual payments to BURBANK could not be met promptly and notes had to be given him in lieu of cash. The pinch was due to a variety of causes, one of them being over-expansion with consequent high overhead, especially rentals and salaries, but from the Company viewpoint the difficulty was caused by the failure of the BURBANK novelties to make good; to the high prices exacted by BURBANK for his novelties; and finally to the

[99] Conversations with Mr. SMITH, November 8, 1941.

heavy hand he held over the Company by exercising his prerogative of approval or disapproval of its officials and policies. Whether the Company was coerced into trying to sell unsaleable things now is not clear. BURBANK had a contract to deliver everything that was ready for release and doubtless he saw no reason why they should not receive them, start them through the expensive process of multiplication, and finally place them upon the market. And of course he wanted his money.

In 1914 the Company continued to expand and BURBANK was becoming more and more insistent that he be paid what was due him. The newspapers of the time stated that BURBANK was about to bring suit against the Company, although many were pleading with him not to do so. The Santa Rosa Press-Democrat of December 31, 1915, said:

"After having waited and waited for the Luther Burbank Company, the Company which took over his seed and other productions, to pay him what he had been owed for a long time, LUTHER BURBANK has commenced a suit against the company in the superior court of San Francisco to recover the sum of $9,775 due on promissory notes.

"Further than this, Mr. BURBANK has notified the Company of his cancellation of the contract which bound him to turn over his creations to the company. In other words, the expected has happened, and what was once one of the most golden opportunities upon which any concern had to build up a tremendous business, has been allowed to dwindle owing to gross mismanagement of its affairs.

"From San Francisco Thursday came word that Manager PITTS and the directors will put forth every endeavor to get Mr. BURBANK to reconsider the course which he has decided upon and for which he cannot be blamed in the least, for his experimental ground expenses do not cease as his great work proceeds. There is to be a meeting between the directors and Mr. BURBANK next Monday.

"In the event of Mr. BURBANK deciding to adopt the course he has outlined and refuses to allow his name or his products to be handled by the Company, then there will be nothing to do but to liquidate the concern. It is well known that Mr. BURBANK has been willing to do most anything to keep the company in operation if the contract was lived up to. Among the stockholders in Santa Rosa, and there are a number, and elsewhere, there are some of his most intimate friends.

" 'BURBANK has been the victim of stock pirates,' said Attorney WISE. 'This Company was formed three years ago. He took no stock in it and no interest in it. Some of the best men in town have also been made victims. . . . Stock to the amount of $375,000 has been sold to the public at par. The Company agreed to pay BURBANK $300,000 in terms of $30,000 cash and $15,000 a year. They were to have exclusive rights to sell all his products.

" 'They paid him the $30,000, sold stock like hotcakes and never paid him another dollar. BURBANK has delayed action for a

year because of sympathy with the excellent people involved. He has now cancelled the contract, forbidden use of his name, and has brought suit for $10,000. Another suit will be brought for $15,000. These suits are arrearages.' "

There were criminations and recriminations, including a libel suit against Attorney WISE, BURBANK's lawyer. Pleas were made to BURBANK to stay his hand; to give the Company more time; that disaster on a big scale would result if he persisted in going through with the suit and forbidding the Company to use his name. But BURBANK was thoroughly angry; his resentment had been growing for months. When I visited him three months earlier,[80] with flashing eyes he declared that the Company had swindled him out of everything he had, which, of course, was an exaggeration but he was crippled financially with his normal income from sales having been cut off for two or three years and his regular maintenance expenses going on all the time.

At any rate he stuck by his guns and on February 8, 1916, the Company was declared to be insolvent. The assets were small and stockholders received little or nothing. BURBANK held preferred claims but even he lost heavily, although he did regain possession of a considerable stock of seeds and plants that remained unsold.

After his experience with the two bankrupt firms, BURBANK was a changed man — something had gone out of him. To seem in the eyes of men to be a failure was galling, even humiliating. Many of his personal friends suffered financially from the two catastrophes, but it was known that he had probably suffered greater money losses than any of them and local people, understanding his embarrassment and feeling that he had been imposed upon, did not hold any personal resentment against him.

BURBANK rehabilitated his business as rapidly as possible but by the time all legal adjustments were made the season of 1916 was too far advanced to sell anything. He intimates, also, that there was little stock on hand of the things he valued, for it has already been recounted that the Company was in the general seed business rather than dealing in BURBANK specialties, as the world believed.

This chapter of BURBANK's life closes with an official statement, under date of July 1, 1916, in the form of a leaflet, which he no doubt distributed widely, to the effect that the Company was out and that he was again in sole charge of his seed and nursery business.

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[80] Santa Rosa Press-Democrat, September 4, 1915. "A party of horticulturists, members of the American Pomological Society, now meeting in Berkeley, visited LUTHER BURBANK today. The group consisted of Prof. W. T. MACOUN, Dominion Horticulturist of Ottawa, Canada; Dr. W. L. HOWARD, Associate Professor of Pomology, University of California at Davis; ELTWEED POMEROY Jr. of Donna, Texas, Vice-President of the Texas Horticultural Society; Prof. L. R. TAFT, East Lansing, Michigan, and VESTA C. HANEY of East Lansing, Michigan. Governor BRUMBAUGH of Pennsylvania also visited BURBANK the same day." My party had to leave early, but at Mr. BURBANK's special request, I remained three hours longer.

## IX

## BURBANK THE PARIAH — OF SCIENTISTS

TO THE Brahmans of science BURBANK was an Untouchable. They almost dreaded his shadow. His literature was taboo; hence few preserved his seed and nursery catalogs. If one valued his reputation among his colleagues, he must not be caught with a BURBANK catalog on his desk or a BURBANK book upon his shelves. Extremists regarded him as a parody — an imitation scientist — and his bid for recognition as ridiculous. To be sure there were liberals here and there, but they seldom raised a voice in protest.

BURBANK's practical attainments were of no avail. They were either disbelieved or ignored. Many, both in and out of scientific circles, did not know what to believe. There were conflicting stories and prejudice was rife. Had not men of orthodox training tried to improve economic plants by breeding — by following the most approved methods of technique and record-keeping — and got precisely nowhere? Then how could one who violated all the rules expect to be successful? For a Brahman to admit such a possibility would be a reflection on his caste.

The chief period of controversy comprised the years 1893 to 1912. Those were also BURBANK's most productive years; and had he passed out of the picture at the end of that time and a balance been struck, the historian's task of summing up his career would have been simplified. After that there was less to his credit and more to apologize for. While it is true that the adverse opinion of the scientific world was pretty well hardened by 1912, events of the next few years tended to confirm that view, and unfortunately — as well as unjustly — a considerable portion of the lay public either was converted to that belief or left hopelessly bemused.

A potent reason why he was beyond the pale of institutional scientists was the fact that he engaged in the nursery business. That this situation was forced upon him was beside the point. Pursuing the methods of the nurseryman and observing the ethics of the plant salesman of his time, he marketed things of doubtful value. All of this was violently contrary to the ideals of the scientific profession and made him an object of mistrust. Rival nurserymen helped to plant seeds of suspicion against him. Did he really produce by breeding the new plum trees he was selling, or did he bring them all direct from Japan? Was the Shasta daisy truly a product of breeding or an importation from somewhere? Did he breed a race of cactus devoid of spines or did he only bring in the different thornless types intact, from Mexico or Africa? And finally, was there any merit to his claim that he had successfully

produced a new species, as claimed, by hybridizing the western dewberry (*Rubus ursinus*) with the Siberian raspberry (*Rubus crataegifolius*) ?

If science stands for anything it is truth and accuracy in deed and statement. Students have been taught that a legitimate scientist does not ask the world to accept his unsupported word for statements he may make in announcing the discovery of a new truth or an improvement on an old one: he submits the evidence on which his conclusions are based. This is the picture of a conventional scientist, such as is fostered by educational and research institutions of all civilized states.

But science is a tool that is used for many purposes — for war, peace, industry; for the cure of the sick and alleviation of pain; to prevent accidents and unnecessary hazards; to improve government; for the detection of crime; for the promotion of human happiness. Its uses and objectives are legion. We come into the world under its ministering hand, and go out again in spite of all our accumulated knowledge, because in many directions science still stands baffled by the laws of Nature.

One universal use of science is for the promotion of commerce and industry — for personal gain, if you will — and these in all their ramifications make government itself possible, for, of course, this benevolent parasite on the body politic must be supported. Manufacturing and processing may be, and usually are, highly technical, and these various technologies are based on one or more of the sciences.

A knowledge of science or the technological use of it is not necessarily acquired in the laboratory of an educational institution although that is the usual way. There is such a thing as the scientific temperament. Some are born with it, some are not. I do not mean to assert that scientists are born, not made. But I do mean that an individual with a small talent of this character may, by cultivating it assiduously, in lecture room and laboratory, become a fairly proficient technician; while another with a pronounced talent but with only meagre cultural opportunities may, by following his bent his own way, succeed in accomplishing something worth while, without formal training.

Almost without exception the authoritative scientists of the world have had talent as well as opportunities for cultivating it. The institutions of the country are manned from this group. Here and there in history we learn of individuals who, though handicapped by lack of formal training, have nevertheless risen above their environment and become famous for their accomplishments. But their task was made doubly hard because those with formal training are extremely skeptical of the accomplishments of individuals who are not formally trained and at best are liable to accord them only grudging recognition.

GEORGE STEPHENSON the elder was ridiculed by the educated engineers of his day when he was building a locomotive designed to draw a train of cars. Why? Because it was known that he

never learned to read and write until he was past seventeen and that what little elementary education he had was obtained by attending a night school. ROBERT FULTON had much the same experience when he was about to navigate the Hudson by steam power. MENDEL, the monk, was ignored by the botanists of his day when he published his epoch-making paper on the laws of inheritance of characters in the garden pea. Educated, yes, but nothing serious in the realm of science could be expected from the clergy! CYRUS W. FIELD, builder of the Atlantic cable, was thought to be a featherbrain. EDISON and MARCONI had to fight for recognition because as scientists they were not to the manner born. CHARLES DARWIN, educated for the Church, was something of an exception. He no doubt would have been ignored by scientists on account of the character of his education but he simply overwhelmed them with the mass of evidence that he submitted in proof of his convictions regarding the origin of species and related matters. But perhaps the most humiliating experience of all was reserved for the WRIGHT Brothers when it became known that they seriously thought they could build a machine that would enable men to fly. What could be expected of two young men who had barely completed high school? And SAM LANGLEY, an educated man, who had faith in their ideas, was ridiculed to his death.

BURBANK had the research temperament. In fact he was a "natural." But to the conventional scientists of his time — especially botanists; later, plant breeders; and still later, geneticists — he was an Untouchable. Others took their cue from workers in the biological sciences, for presumably they knew BURBANK best; and because caste is strong, the word has been passed down the line to this day. While BURBANK was alive they rarely went near him, never tried to ascertain the facts, and many of them would have been embarrassed to be caught reading anything he had written or any of the books that were written about him. I have contacted scores of scientists, young and old, and find, almost without exception, that they speak kindly of him as a man, but those under forty or fifty are apt to say they have "understood" that, scientifically speaking, he was not to be taken seriously.

From the older biological scientists, especially those in Colleges of Agriculture where men must be realists and in Federal departments having to do with plant culture and improvement, we hear a very different story. With only a small dissenting minority these groups show a willingness to commend BURBANK's virtues and forget his faults. They point out that he accomplished much direct good in the world by his contributions and even more, indirectly, by the stimulus he gave to plant breeding.

Without trial and without seriously trying to determine all of the facts, BURBANK was condemned by institutional scientists on at least six counts: he was untrained in science; he was a nurseryman — sold trees, seeds, etc.; he permitted people to make exaggerated claims for his prowess — even linking him with the supernatural; he was lacking in humility — fought back when

criticized; he knocked at their door — or allowed his admirers to do so — when he should have waited for an invitation to enter; and finally he did not have the attitude of a scientist — did not conform — and his methods, it was charged, were so unreliable as to vitiate or invalidate his conclusions.

## X

## BURBANK THE DISAPPOINTED

OF COURSE, the major disappointment of BURBANK's life was that he was not accepted whole-heartedly by the scientific world. However, an element of pathos permeates the situation, for deep down in his consciousness I cannot believe that he personally cared much whether he was accepted or not. To have been accepted would have been merely a saving of face, a balm to his pride, because throughout most of his life certain things were expected of him by his family and his admirers, and he simply had to live up to expectations. Time and again well-meaning friends, who mostly did not know the meaning of the word science, had told him that he was a scientist and proclaimed him to the world as such. His enthusiastic biographers carried this idea to lengths that bordered on the ridiculous, especially HENRY SMITH WILLIAMS, who tried to prove that BURBANK independently discovered and demonstrated the basic principles of heredity — afterwards known as MENDEL's law — at least a year before the announcements of DE VRIES, CORRENS, and TSCHERMAK, but the job was so cleverly done that BURBANK seems to have tried to believe that all he said was true.

If his friends had been more moderate in their demands for recognition of their champion he might have been happier. Laurels enough had come his way to satisfy most men. He loved adulation but his friends and those around him seemed to want the unattainable. They wanted him proclaimed a second DARWIN and have his name in the textbooks. ROBERT JOHN and OSCAR E. BINNER actually announced plans for having BURBANK write a series of books to be used by college students, but before they got around to it their bubble burst. And perhaps it is just as well they didn't. What the proposed books were to teach was not made clear but presumably they were to be made up from material in the 12-volume set[a] that was published by the Luther Burbank Press; however, I fear they never would have been adopted as texts by any college or university and their rejection would have been humiliating to the author.

It should be understood that the publishing of textbooks was not BURBANK's plan but a scheme of promoters for making money. Possibly the announced plan was only propaganda for selling more stock in the publishing enterprise and BURBANK was their dupe.

A keen disappointment in BURBANK's life was the way the clergy turned against him when he needed their support and felt that he had a right to expect it. He hadn't asked them to seat him

[a] LUTHER BURBANK, His Methods and Discoveries and their Practical Application.

upon a pedestal. But he accepted the distinction, and, despite official denials to the contrary, he was terribly hurt when they toppled him over. Also, heaping indignity upon injury, they refused to understand him when he sought to explain his position. This intolerant attitude gave him a taste of medieval cruelty that cut him to the quick. He was no heretic that needed to be forced to recant; he had never professed to believe some of the things the clergy considered basic to Christianity; they had merely assumed that he did.

Of course, I do not know whether he ever admitted to himself that he had allowed his admirers to give him a false build-up and that he had passively accepted it along with other forms of adulation that were hard to live up to. But it is not likely that he would convict himself of anything smacking of hypocrisy or insincerity. He had set himself up as a moralist and guide for children and youth to follow, and perhaps it was not illogical that the clergy should take the rest of his beliefs for granted. It may have been a misunderstanding or it may have been wishful thinking; it all adds up to the same thing. Even though a few clergymen came to BURBANK's rescue and did their best to defend him and give him a chance to defend himself, the gesture was futile. He was engulfed by the storm and had to accept the situation. He took refuge behind his philosophy of kindness and good will towards all, then shrugged it off and tried to forget. But he emerged with a certain understandable bitterness and mistrust toward the Church which never left him. However, all this, I believe, had nothing to do with the atheistic setting of his funeral when he died a year or two later, at least insofar as his own wishes were concerned. He had arranged long before for a distinguished atheist (Judge LINDSEY) to deliver his funeral oration but the Ingersollian burial service was another story, as related elsewhere in these pages.

Minor disappointments in his life were the years of anguish following his unfortunate first marriage and his differences with the Carnegie Institution which granted him a generous subsidy and then withdrew it. Not that he was not relieved to be free from the tyranny which their discipline imposed upon him (from his viewpoint) but the withdrawal of the subsidy caused him to lose face, and in this regard he was as sensitive as a Chinaman. The same principle was involved when his friends tried to prevail upon Congress to set apart a large tract of desert land in the Southwest for a demonstration of the value of spineless cactus as a stock feed, and the plan was turned down. The measure was approved by the House but was allowed to die in the Senate. I don't think BURBANK wanted the land. An ironic feature of the case was that the measure was not defeated on its merits but because cactus selling, for planting purposes, had become a racket, and dealers were using the pending legislation to mislead their deluded customers. In itself, the idea was a meritorious one. If carried out it would have brought a show-down on the value of this crop which, by the way, might have introduced another disappointment into BURBANK's life.

## XI

## BURBANK THE WORLD CHARACTER

FOR thirty years BURBANK was definitely a world character. He was visited by royalty and notables from most of the principal countries of the world. His place at Santa Rosa was a mecca for tourists. As he became a legend, his gardens became a shrine.

BURBANK was a master showman. He had the good sense to appear natural, even when he must have been inwardly perturbed in the presence of numbers. The good opinion of himself that he held, combined with a certain shyness, enabled him on all occasions to maintain a serenity and poise that was charming in its seeming simplicity. His self-assurance would not permit him to kowtow to the rich or the mighty ones of the earth, nor to indulge in socio-political tricks to win the plaudits of the proletariat. All comers were required to meet him on his own terms and, such was his assurance, they could accept him or leave him — it mattered not a whit to him. It was all in the day's work.

Various motives brought the people to his door. The majority came out of curiosity, not exactly as they would go to the zoo, but to see a notable they had heard much about like taking a peek at the President of the United States or some reigning monarch, or visiting them if they dared. To shake hands with him was a benediction, something to treasure as a unique experience — like the old crone in the story who was wont to say, "Children, these old eyes of mine once beheld Queen Victoria." And I feel bound to add that these statements are not intended to be ironic, and they are not overdrawn.

It is not surprising that certain of the visitors harbored strange ideas about the man, that they somehow expected to see a freak — some one with an extraordinarily large head, or wearing a halo instead of a hat. It was not uncommon for a sightseer in a crowd to remark to a companion in all seriousness, as though thinking aloud, "Why, he's only an ordinary-looking man and not a very big one at that. It's hard to believe he has done all the wonderful things I have heard about."[23]

Many, perhaps most, of the curious were admirers of BURBANK and, of course, when they visited him it was in a spirit of reverence. Along with the merely curious they were content to remain outside the low picket fence and patiently wait for a glimpse of their hero as he went about his work. These loiterers were often a source of irritation and annoyance to BURBANK, as they were apt to enter into conversation with employees with the

[23] Conversations with persons that were employed by BURBANK.

**BURBANK'S TWENTIETH CENTURY GLADIOLUS**

OFFERED FOR THE FIRST TIME
WITH OTHER NEW AND RARE

# BULBS

MOSTLY UNOBTAINABLE ELSEWHERE

1911-1912

**TO JUDGE NOVELTIES: LOOK TO THEIR SOURCE**

## The New Gladiolus: A Revelation

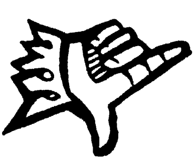
THIRTY years ago the Gandavensis type of Gladiolus was the leader, but the flowers were so fugacious that they were of no value in dry, sunny climates, the flowers wilting each day almost as soon as opened like the flaccida type of Cannas. By several years' growth of seedlings and most rigid selection a new strain with short, compact stalks bearing flowers of great substance was produced on our farms. This strain was introduced in 1889. Later, as other matters required attention, the entire stock of these was sold to Mr. A. Blanc of Philadelphia, and Mr. H. H. Groff of Simcoe, Ontario, Canada; we had before sold many of these to other well-known growers of that time. (See Bailey's Cyclopedia of American Horticulture, page 647.)

"Gladiolus America" has been esteemed both by American and European growers as being by far the most vigorous and easily grown Gladioli known. When "America" first came into our hands, several years after our first experiments along this line had been discontinued, its vigor and other general good qualities induced us to make one more effort to improve the Gladiolus. All the beautiful Gladioli here offered, and others even more beautiful still to be offered, originated on our farms from America as the seed parent, but all new or unusually choice or unique varieties obtainable anywhere at any cost were used for pollen parents. The results, after a few years, were astounding and we now have without doubt the largest, most brilliant and most varied ones growing on this earth, and of a new and distinct type. We happen to know this, not only from experience and actual comparison point by point, but these facts are corroborated by those who are growing Gladiolus themselves and who have carefully examined the stocks of those grown by practically all the great American and European growers. These new ones are a revelation in this the most varied, most popular and most easily grown of all bulbous plants.

The Gladiolus in California thrives perhaps as nowhere else, growing with a vigor and freedom from fungous diseases which elsewhere is wholly unknown, and the growing season is so long that the bulbs never need to be disturbed until fully ripened.

The varieties offered this season are especially rich in scarlet, salmon and crimson shades, which are now most rare and most sought for in all collections. The flowers of most of these are enormous and remarkable as well for their substance as for unusual size and brilliance of colors.

"The more impossible, the more certain it can become."



This new Burbank strain of Gladiolus will take its place in the hearts of the people like the Shasta Daisy: the most world-wide popular flower creation of the century . . . .

"He laughs best whose laugh lasts."

LIBRARY
N. Y. STATE COLLEGE OF AGRICULTURE
ITHACA N. Y.

TEXTFIGURE 4.—COVER OF A 1911/12 LEAFLET.—BURBANK introduced more than fifty gladiolus varieties over a period of forty years. Several of these remained in the trade for ten to twenty years. He gave particular attention to varieties calculated to withstand the hot, dry winds of California. Several with specially stiff petals, quite different from ordinary types, were originated. The hyacinth-like arrangement of the flowers around the spike was also his contribution. Becoming discouraged on account of the ravages of gophers, he sold his entire stock to a Canadian fancier.

object of enticing them up to the fence to wheedle them out of a flower or fruit, or to make a chance for purloining something that would serve as a souvenir. Some were venal and tried, directly or indirectly, to snitch seeds or cuttings of things which they hoped might be valuable.

Among BURBANK's visitors was always a small percentage of scoffers. These were certain to stalk employees for the purpose of asking them questions often innocent, but sometimes of such a nature that they did not have the courage to put them to BURBANK, himself, even if they had had a chance to meet him. This matter of talking about BURBANK or his work was a source of supreme annoyance to BURBANK as he allowed no one to speak for him on any subject. If he caught a workman talking through the fence to a visitor, no matter how innocent the subject, he would fly into a fit of anger and occasionally the worker would be discharged.

After suffering much annoyance and some pecuniary loss BURBANK made a strict rule that employees in the gardens were to talk to no one either inside or outside the fence. He went a step further and instituted a system of searching the workers' pockets as they left the grounds. As one former employee remarked, "he treated us as 'high-graders.'"[88] For these and other reasons BURBANK changed workmen frequently and gained the reputation of being a difficult man to work for.

One class of visitors went to see BURBANK for educational reasons. This group included botanists, horticulturists, plant-breeders (both amateur and scientific), nurserymen, professional men and women, and others who hoped to gain information, extend their knowledge or enjoy the handiwork of one they regarded as an expert in his field. The professors viewed and appraised with scientific thoroughness — sometimes tinged with cynicism; the nurserymen looked with envious eyes at the long list of specialties such as they had dreamed of but never expected to see in real life; while others who had come to satisfy a yearning for a composite of beauty, the wonderful and awe-inspiring gazed on the whole picture of BURBANK's accomplishments as they would the Acropolis at Athens or a sunset from the heights of Taormina, and with much the same emotions.

BURBANK was a satisfying showman in the sense that no one regretted the time spent with him. He rarely made the mistake of keeping his visitors too long or showing them too much; they always went away hungry for more.

Visitors were an excellent source of favorable publicity — especially those that were received in person by BURBANK. All visitors that presented themselves were not received. No, not by any means, for this would have required all of his time. Those that were so fortunate were usually grateful for the privilege and became his loyal supporters. They told their friends and then the

[88] A term used at the gold mines to indicate persons who steal bits of high-grade ore. Even with the most stringent regulations mine owners experience considerable losses from this practice.

friends came; these in turn told their friends and so on, the volume growing by accretion like the proverbial snowball.

News writers were an even more potent source of publicity than visitors. H. W. SLATER, a newspaper man of Santa Rosa, claims to have given BURBANK his first effective push toward fame by way of the publicity route, about 1895, when he had contracted with a customer to produce a hardy tea rose for which he was to receive $5,000. This was spectacular enough to attract wide attention, not only for the feat itself, but for the princely reward as well. Stories of this kind have a way of traveling across oceans.

BURBANK's first bid to fame in the scientific world came with the publication of his catalog *New Creations*, in 1893. While this announced some of the best and most lasting things he ever produced — Japanese plums, Shasta Daisy — it is worthy of note that his fame, with the masses, did not stem from these attainments so much as from some of his more spectacular feats of much less importance, such as production of the plumcot, wonderberry, and spineless cactus. The press dramatized these achievements and the appeal was irresistible.

Chief among men of science, who were most effective in vouching for the authenticity of BURBANK's work — introducing him to society as it were — should be mentioned DAVID STARR JORDAN, President of Stanford University, and Professor HUGO DE VRIES, the Dutch botanist. JORDAN, with more or less help from his colleague, Professor VERNON KELLOGG, gave BURBANK considerable fame in his own country, but it was DE VRIES, unaided, who established his international reputation as a marvelous manipulator of plants and one who had performed wonders in hybridization. Of my own personal knowledge covering the twenty-five year period — 1905 to 1930 — I know that BURBANK's name was well-known in scientific circles in the principal European countries. Dealers in seeds and plants were even more familiar with his hybridizations — many of them being customers for at least a few of his productions in fruits and flowers.

In far-off places like South Africa, New Zealand, and Australia along about 1912 BURBANK was as well, or better, known than in the United States. Because his plums are a staple crop in South Africa, BURBANK still is highly thought of there, but in Australia his reputation suffered on account of the thornless cactus fiasco.

European botanists and geneticists were frankly skeptical of BURBANK's reputed attainments, regardless of the accolades of JORDAN and DE VRIES, for the reason that he had not published his findings in the usual way, in scientific journals. But there were the uncompromising statements of DE VRIES, a colleague in good standing, one of their own caste, and what could they do about it other than to accept what he said? Biographies of BURBANK by CLAMPETT, HARWOOD, and HENRY SMITH WILLIAMS, fortunately, they had not seen.

It must be acknowledged that part of BURBANK's reputation among the masses was due to notoriety rather than to fame. The

sayings of cheap writers and punsters may make a name a household word, possibly with unflattering implications, but at the same time there's no denying it helps to make the person a notable. Vaudeville jokesters do not make use of a name unless it is well-known, thus making it better known. BURBANK didn't like his name used in jocular vein because he hated ridicule; EDISON ignored such references, and HENRY FORD turned the jokes on his tormentors by capitalizing this kind of publicity.

First and last the church gave BURBANK a large amount of publicity by holding him up as a moral example for the youth of the land to follow; and later the Fundamentalist element condemned him to perdition because he insisted upon expressing opinions which they interpreted as being at variance with their own ecclesiastical beliefs.

Another source of undying fame to the name of LUTHER BURBANK is to be found in the public schools where a whole tribe of earnest teachers, mostly women, are perpetuating his name to the rising generation by picturing him as the hero of his time. In moderation this practice is to be commended but it would be unfortunate if children were left with the idea, even by implication, that he was a super-man in the sense that he could perform miracles.

Finally the United States Post Office Department, in the spring of 1940, put the crowning touch on all recent publicity by issuing a commemorative BURBANK stamp. Fifty millions of these three-cent stamps were sent out. They went to all first- and second-class post offices and to any others requesting them. This insured a wide distribution.

The BURBANK stamp was a part of what the Department called its "Famous Americans" series consisting of 35 intellectual leaders of America, five artists, five authors, five composers, five poets, five inventors, and five scientists. The others picked as scientists besides BURBANK were Dr. CRAWFORD W. LONG, credited with being the first physician to use ether as an anesthetic, Dr. WALTER REED of yellow fever fame, JOHN JAMES AUDUBON, the naturalist, and JANE ADDAMS of Hull House renown.

Within his group BURBANK was given the place of honor by placing his portrait on the three-cent stamp, which is far and away the most used stamp turned out by the Government. AUDUBON was assigned to the one-cent denomination, LONG to the two-cent, REED to the five-cent, and ADDAMS to the ten-centers.

Naturally there was much discussion about the entire list of "intellectual leaders of America," but one commentator[84] voiced the thoughts of many when he said: "Most controversy will be caused by the face of BURBANK upon a stamp. He is rated as a great gardener rather than a great botanist. Scientists by the dozen have equal reason for being honored on our stamps. JOSEPH HENRY, who ranks with FARADAY as the father of the electrical industry;

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[84] WATSON DAVIS, Science, p. 10 of Supplement, February 23, 1940.

BENJAMIN RUSH, early physician of Philadelphia; ASA GRAY, the botanist; BENJAMIN SILLIMAN, early Yale chemist; JOSEPH LEIDY, E. D. COPE, and OTHNIEL CHARLES MARSH, great explorers of ancient and living animals; and WILLIAM H. WELCH, a great pioneer in medicine."

How are the names of notables secured for the honor of being placed on stamps? Who proposes them in the first place and what is the basis of evaluating their merits? Are the names chosen by a committee of persons qualified to judge achievement in the various fields of intellectual attainment? The Post Office Department gives this explanation:[85]

"Requests for [names to be used on] each new issue of postage stamps are received from so many different individuals in various sections of the country that the Department is not in a position to give credit to any one person for having offered the original suggestion. This applies to the majority of stamps in the Famous Americans Series, suggestions for which have been filed with the Department over a period of years. It was not until definite decision had been reached to provide a series of this character, about a year ago, that we began the research work incident to the selection of those entitled to recognition therein. No special committee was assigned to this task, the selections being based on the relative standing of the individuals in their respective fields which appeared to make them eligible for inclusion in the series. It was considered that a place should be provided in the group of scientists for LUTHER BURBANK in view of his noteworthy contributions to plant development."

[85] Letter to the author from RAMNEY S. BLACK, Third Assistant Post Master General, May 8, 1940.

## XII

## BURBANK THE INDIVIDUALIST

BURBANK seems always to have lived to himself and within himself. Even as a boy and very young man he was an individualist. While he was in school, which was up to about age eighteen or nineteen, he was not very different from other boys. Even when he took employment in his uncle's machine shop and later when he began working for his mother he appears to have cultivated the habit of reticence so far as his plans and thoughts were concerned. He did not physically withdraw himself from the life about him but in his thoughts he dreamed of a different life.

While gardening to support the family his thoughts strayed along unusual paths. For example, other boys, no doubt, had mused on the advantages of having types and varieties of vegetables that would mature a week or two earlier than usual, but young BURBANK did more than muse — he began to cross-pollinate promising varieties with the hope that some of the resultant hybrids might be earlier than their parents. And here he learned a great lesson — perhaps the first in his long career as a plant breeder — which was, that it is impractical to expect a new character, like earliness, to appear in the first generation of hybrids — that is, as the result of a single cross. However, his failures in this respect tended only to stir his imagination and stimulate him to further effort. Naturally his hard-headed, practical neighbors thought his experiments were a sheer waste of valuable time; and this failure to understand the boy caused him to retreat still further into his own world of introspection. To be rated as queer and treated as an eccentric character usually has a depressing effect, especially on a young person, but it is to BURBANK's credit that he had sufficient confidence in himself to stick to his ideals despite the discouraging attitude of his elders, but in doing so he had to walk alone.

It seems to me that this was the chief reason why he tore himself away from his childhood home and put a continent between himself and those who knew him. In his new home in California circumstances forced him to become a recluse. True, he could have found friends of sorts had he been willing to spend his idle time — of which he had considerable, at first — at the local poolroom or similar loafing places but he preferred the company of his own thoughts.

He perhaps always had an inferiority complex so far as the social graces were concerned but this fact never depressed him, because the deficiency, if it can be so designated, was more than offset by a confident feeling of superiority which at long last bur-

geoned and developed into arrogance. Small wonder then that he was awkward and ill at ease on chit-chat occasions but serene enough with inner grace when he could talk about his specialty.

When BURBANK became a world character he was besieged by visitors, many of whom he desired to see or was willing to give a part of his time; but there came a day when it became necessary to curtail even a selected list of callers and yet he was so self-centered and so jealous of his reputation that he could not, or would not, let any one help him. He never had a confidant or anyone he would trust to represent him. It has been told elsewhere how he would not keep an employee who felt that he was competent to entertain visitors; that was a task that he would entrust to no one. The establishment was a part of himself, and no one but he, himself, could tell the story or any part of it authoritatively and just as he wanted it to be told. It was wholly a personal matter with him — this telling — and he could not share it with anyone; no amount of pleading or scolding by those who loved him and had his welfare at heart — his mother, sister, or brothers — could break this resolution. He was truly a one-man institution.

Among BURBANK's legion of admirers there was much concern about the future of the great work he had begun. They wanted to know what provision he had made for its continuance. Most of his friends knew that he never had had a partner or anyone he was willing to confide in. Some of the bolder ones even put the question to him but history does not record his reply. Toward the end of his life the question was discussed verbally and in the press. Suggestions were made that this or that individual might carry on for him. I think he was favorable to the idea of converting his gardens into an experiment station under the auspices of Stanford University or the University of California. Both plans had been mentioned but no philanthropist came forward to provide the necessary endowment.

Just what BURBANK, wholly uninfluenced by close members of his family, would have done is not absolutely certain, but from the evidence that I have been able to gather I am convinced he hoped, through some arrangement, that WILL HENDERSON, a trusted employee, would carry on his work. Whether he envisioned HENDERSON's carrying on at the old stand, or elsewhere, is not clear. Apparently he never thought the problem through, or family opposition was too great, or something prevented his coming to a final decision, for he never made any definite commitment to HENDERSON, although he had done the unprecedented thing of giving him some foundation stock of certain plants which needed further improvement. This was only a few months before his death and the implication is clear that he favored HENDERSON somehow or in some manner to be his successor, and HENDERSON, apparently, could put no other construction on his acts and his general attitude toward him. However, on account of opposing influence or inability to make up his mind, nothing was settled. His final illness was brief and he passed away without leaving any

expression of his wishes. He simply bequeathed everything to his wife, a young woman, his former secretary, to whom he had been married for ten years.

It was late in April of 1926 when BURBANK died. Practically all the spring planting of seeds and bulbs had been completed. HENDERSON was discharged and nothing further was done except to get out a final catalogue of price quotations and book orders for the growing crop. All activity in the direction of plant improvement stopped suddenly and with finality, for with HENDERSON's departure no one was left who had the technical knowledge to do anything further.

Professionally speaking, BURBANK died as he had lived and his talents perished with him. He had no son or daughter to inherit his spark of genius and the only understudy he had who might have imitated his art with creditable brilliance was eliminated. The mighty oak was fallen and only the numerous acorns of his achievements were scattered over the earth for others to nourish and thus perpetuate his memory. Perhaps it is just as well that he did not have a successor who might have suffered by comparison, for there could be but one BURBANK. BURBANK, who came from a highly fertile family, was twice married but had no offspring. Sorrowfully and regretfully, people have asked me why. I have no answer.

## XIII

## BURBANK'S ETHICS

PREVIOUS reference has been made in these pages to BURBANK's standards of conduct relating to right and wrong, particularly as applied to the sale of his products. It was stated that his outlook was ever that of the nurseryman and seedsman and that he followed the practices current among the dealers in plants and seeds of his time. He has been accused of overpraising his products and misrepresenting their value. And there have been hints and a few direct charges that some of the things he sold as products of a process of breeding carried on by him were, in fact, old varieties renamed or importations from some foreign country. Speaking in the abstract he was, at one time or another, and in some degree, guilty of all of these things but let us see how it works out in practice.

In the first place, I would ask the reader to pick up a catalogue of any nurseryman or seedsman of thirty to forty years ago who was engaged in business on a national scale and study the statements therein, particularly the descriptions and claims made for new things — novelties — and see how they compare with what was called the highly colored and over-enthusiastic descriptions and claims made by BURBANK. In fairness it must be said that our manner of life has taught us to expect the merchant to be enthusiastic about the virtues of his goods, and we are inclined to criticise and even to mistrust the salesman who has nothing good to say about his wares.

On the whole — from the standpoint of the buyer — the art of salesmanship has been greatly improved. It is now more subtle and less blatant, but exaggeration has not disappeared and probably never will as the public seems to like it. As applied to statements made in nursery and seed catalogues, exaggeration and even hyperbole are not only tolerated but they are expected and serve to leaven what otherwise might be tedious descriptions of new varieties; and the average person has come to look for them and to derive a pleasurable excitement from reading the sprightly descriptions. Few people are so trusting as to believe, *in toto*, everything they read, especially if they remember that the words were written by a salesman who is trying to sell them something. Laws have been framed to protect the artless but without much success.

Wide-awake florists, gardeners, and fruit growers are ever on the alert to obtain the newest things in their line but they are not deceived by the descriptions and claims set forth in the catalogues.

And neither are most amateur enthusiasts, although they are more credulous. Both take the bait: the former in cynical mood, the latter more in a spirit of hopefulness.

The search for new things, then, becomes a kind of game in which the player has good chances of winning, in some degree at least, for cultivated plants are constantly being improved. While many new varieties are disappointing, others turn out to be valuable additions to our nomenclature. The progressive florist, for example, cannot afford to ignore the announcements of new varieties lest he fall a step behind his competitors, but the fruit grower, on the other hand, must be more conservative as trees require several years to come into bearing and a mistake in planting is not so easily rectified as with annuals and other quick-maturing things.

Throughout most of his professional life BURBANK was in the nursery business from necessity rather than from choice. When he sold his general nursery to his partner in 1888 he thought he was out of the business of propagating and selling fruit trees and ornamentals and that, thenceforth, he would only have to produce something new, test it for a time, propagate a few plants and sell them all to one person or firm for a lump sum for cash — "lock, stock, and barrel", as he once said — and then proceed to produce something else. But things did not work out that way. Unable to sell some things at the first offering he had to hold them over and propagate anew — as fruit trees cannot be safely transplanted if too old — or he would sell only a half interest in something and try to dispose of the remainder at retail, himself, which involved more propagating. In a few years, by this process, he accumulated thousands of trees and other plants in nursery rows besides other thousands of seedling hybrids that were under test preparatory to being advertised for sale, the whole amounting to several acres of nursery stock. Thus he continued to be a nurseryman or a seedsman in spite of himself and remained one till the end of his life, but he never liked it. No wonder he fell for the blandishments of promoters when they offered to take over the selling end of his business!

Exaggeration in itself is not necessarily harmful or immoral. Employed in moderation it may become one of the spices of life. But carried too far a picture becomes a caricature and a plain statement of fact is warped into a falsehood. If the innocent purpose of an exaggeration is reasonably obvious it may enliven what otherwise might be a prosaic discourse. The all-important consideration is whether there is intent to deceive. BURBANK had great faith in his creations — for one thing, because he produced them. They were his babies and therefore had to be good, a not unusual attitude for the creator of new plants, mouse traps, or automobiles. And he praised them lavishly. But if we read his descriptions of new things carefully, the eulogies are directed as much at the creator as at the created. He was proud of the job and wanted the reader to share in his pride of accomplishment.

That many of his creations experienced an ephemeral existence did not dampen his enthusiasm in the least. I cannot find it in my heart to censure him for his over-praise of things that had little merit so much as I do the dealers who pushed them upon the public: things like the wonderberry, white blackberry, pitless plum, and spineless cactus.

BURBANK had no system of following up his new things once they had passed out of his hands. The time element made it impossible, just as he had no time for writing up complete records. He assumed that everything he sent out was valuable and let it go at that and turned to other things. What did his devoted sister or his enterprising secretary know about the horticultural value of many of his productions? And they helped him to write his descriptions. They simply took his word for everything and kept repeating statements that should have been modified. I for one do not believe that he meant to deceive.

The foregoing holds good for his fruits and flowers, but with some of his grains the available evidence appears to be against him. Some of the claims about his wheats, which were made in his literature,[86] are worse than exaggerations; they are said[87] by competent cereal authorities to be untrue, that most of them were old, discarded varieties that had been renamed, and the weight of the evidence appears to be on their side.

Toward the close of World War I, when there was great shortage of foodstuffs, especially bread, BURBANK introduced several new varieties of grains, four of them being wheat. He claimed[88] to have spent eleven years in producing them, presumably by a process of breeding. One of the varieties, the Quality, which he described as an early, hard, white wheat, was pronounced by cerealists to be identical with an Australian variety known as Florence. While the Florence had not been grown here commercially, it was well known to Experiment Station workers but was not thought worthy of introduction in this country. Be that as it may, Quality was widely planted in the Northern Plains States in the middle and late twenties as a spring wheat.[89]

In view of the great demand for high-yielding varieties with good milling qualities, BURBANK pushed the sale of this new

[86] BURBANK'S 1918 New Standard Grains, BURBANK'S Experiment Farms, Santa Rosa, California; and BURBANK'S 1919 New Creations and Special New Selections in Seeds, pp. 27-29. BURBANK'S Experiment Farms, Santa Rosa, California, U. S. A.

[87] Statements made to the author orally and by letter by J. W. GILMORE, Professor of Agronomy, a national authority on grain varieties, and Dr. F. N. BRIGGS, specialist in cereal breeding. Both of these men are responsible officials in the College of Agriculture of the University of California at Davis. Also Dr. CARLTON R. BALL, Principal Agronomist, U. S. Department of Agriculture, Washington, D. C. GILMORE was always friendly toward BURBANK; BALL considered both the man and much of his output to be unreliable; while BRIGGS, who belongs to a younger generation, is neutral in his attitude toward the man and his work except in this particular connection.

[88] BURBANK'S 1918 New Standard Grains, p. 3.

[89] United States Department of Agriculture. Technical Bulletin 459: 53, 1935.

variety and recommended its planting as a patriotic duty. The price was $5.00 per pound, or at the rate of $300.00 a bushel. Considerable feeling was aroused because BURBANK at the time was a member of a national committee[90] that was supposed to give competent, disinterested advice about what to plant in order to increase the food supply.

BURBANK often imported plants from foreign countries, usually novelties or little known things, and introduced them here under their botanical names or names of his own or used them as breeding stock. What actually happened in the case of the Quality wheat, at this late date, can only be conjectured. While it is possible that he may have produced a hybrid that was identical with Florence, it is very improbable. Also he could have received a quantity of wheat containing an admixture of Florence wheat; and after planting it, he might have selected the most promising stalks, which turned out to be Florence, but not being acquainted with that name, called it Quality. However, these possibilities are somewhat far-fetched and, I fear, improbable. Another possibility is that he may have obtained a sample of Florence wheat from one of the Experiment Stations in this country, as a number of them were experimenting with it before the outbreak of World War I.

In BURBANK's time, it was not unusual for a nurseryman to rename an old variety of fruit. Sometimes this was done through ignorance or inadvertence, but sometimes deliberately. Scion wood of several varieties might be received from an eastern state for trial on the Pacific Coast. Somewhere during the nursery period a name might be lost or displaced and when the unknown variety came into bearing and was found to be desirable, the nurseryman, not knowing its name, gave it one of his own.

To speculate further, a fruit might be found growing in a farmer's garden; no one knows its name or whether it ever had one. It is taken for a chance seedling and given a name. To this day there are many such trees growing in California and every year fruit is sent to the College of Agriculture of the State University for identification. Most of them are found to be old or obscure varieties while others are pronounced to be seedlings. Throughout the history of horticulture many valuable varieties have been discovered as bud sports and chance seedlings.

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[90] The following printed notice—as a pasted-in insert—was sent out with BURBANK's catalog entitled "*Burbank's* 1918 *New Creations and Special New Selections in Seeds*:"

*To Inspire Planting of One Million Food Gardens*

NATIONAL EMERGENCY FOOD GARDEN COMMISSION

210-220 Maryland Building, Washington, D. C.

CHARLES LATHROP PACK, President; PERCIVAL S. RIDSDALE, Secretary

LUTHER BURBANK, California
Dr. CHARLES W. ELIOT, Massachusetts
Dr. IRVING FISHER, Connecticut
JOHN HAYS HAMMOND, Massachusetts
FAIRFAX HARRISON, Virginia
Hon. MYRON T. HERRICK, Ohio
Dr. JOHN GRIER HIBBEN, New Jersey
EMERSON MCMILLIN, New York
CHARLES LATHROP PACK, New Jersey
A. W. SHAW, Illinois
Hon. CARL VROOMAN, Illinois
Capt. J. B. WHITE, Missouri.
Hon. JAMES WILSON, Iowa

No horticulturist has the skill to recognize every variety of a given fruit that has ever been grown in this and other countries, so the practice of giving names to unknown things that are found cannot be indiscriminately condemned, for they might be something new and prove to be valuable. Conspicuous examples, to mention only two, are the Delicious apple and the Concord grape.

BURBANK may have imported a few things — chiefly ornamentals — from far-off countries and given them names of his own; it would not have been unethical if he had, but I do not know of any authentic case of his having done so with a fruit. However, he came pretty near it when he brought over the Burbank and Satsuma plums, which may have borne variety names in their home country of Japan.

As related earlier, something seems to have happened to BURBANK after he took back what he could salvage from the wreck of the Company failure. He was not only a sadder, wiser, and much chastened man, but his ideals had undergone a change. He now did less research and more and more seemed to be out for the money. He continued to experiment with bulbs but appeared to concentrate on having things sent to him by collectors from Chile, Australia, and other places, and to pick up oddities and novelties at home. The large collection of fruit tree seedlings in his Sebastopol orchard, seven or eight miles from Santa Rosa, continued to yield a new fruit now and then but his seed business was gradually monopolizing his time and facilities. As most of the things he was now growing were annuals, his routine became a matter of sowing, reaping, and selling. Rather suddenly he became a merchant instead of an experimenter. This was a new development in his life. Never before was there any real evidence that he was more interested in gain than in reputation, that is, fame as a plant breeder.

Then he decided to get rid of his experimental orchard. In a letter to one of his old customers[91] on June 2, 1924, he wrote: "You will notice by enclosed circular that I am offering my Sebastopol place for sale as my seed business has grown to such enormous proportions that I cannot well attend to both." No acceptable bids being received for the orchard he, perforce, had to keep it. New varieties continued to show up which he considered worthy of being introduced, but instead of propagating them himself as of old, he farmed out that task to the Armstrong Nurseries of Ontario, California, and this arrangement continued until his death in 1926. He was definitely out of the nursery business after about 1921 or 1922.

After becoming a seedsman BURBANK added nothing to his reputation as a plant breeder. During his lifetime he had recognized two roads that he might follow — one leading to fame, the

[91] H. E. V. PICKSTONE and Brother, Limited, Simondium, Cape of Good Hope, South Africa. (This company kindly loaned me their complete file of correspondence with Mr. BURBANK covering a period of nearly thirty years. Author.)

other to wealth. He has told us many times that he deliberately chose to disregard profit if it interfered with the attainment of his ideals — the improvement of economic plants and, by inference, the attainment of fame. Selling his profitable general nursery business in 1888 supplies proof of his sincerity. That the course he then decided to follow proved also to be moderately profitable is beside the case, for he could not know that it would be so, though cannily he may have foreseen such an outcome.

The point is that he continued to be consistent until the last few years of his life when he definitely forsook this road for the one leading to profit. We have his own word for it. Why this abrupt change in his ideals we do not know for certain. Evidently there was a sudden need or desire for money. Could it be that he resolved to capitalize his fame — the magic of his name — and the faith people had in him, by going into the general seed business and using his own productions as leaders or lures to attract customers for the standard or common varieties which he could purchase at wholesale or grow with little effort and expense?

His change in policy began to be noticeable in the publications he issued following the failure of the Company in 1915. More and more seeds were offered and less and less bulbs and woody plants. This reversal of policy stands out boldly when it is recalled that his real renown was based upon his researches with fruits and bulbs and not with plants that are propagated from seeds. It was in the early twenties he announced[m] that he had gone out of the nursery business and was giving his full time to growing seeds — flower seeds predominating. The seed business grew rapidly. At first it was announced that all his seeds were "new creations." Then there were two lists, the "new" and the "standard," the last being common commercial varieties not originated by him. Finally there was only one list containing both old and new kinds with no directions for determining which was which. Worse still, certain items were definitely stated to be BURBANK originations, while the reader, unacquainted with varieties, was left to infer that the others were, too, although nothing was said about their origin. The inference was strong that all were his, but he actually made no such claims. All of which is unlike the BURBANK we knew previous to 1916 or 1917.

One sound reason for his change in policy was that he needed money to recoup his recent losses. But, in view of his previous record, this explanation seems inadequate. Apparently as early as 1916 something mundane had happened to becloud his mission, to dull his Messiahship. This was the year he acquired a young wife, a woman with understandable ambitions. Could this have been one of the reasons for his change in outlook? The assumption would seem reasonable. There had, also, been a cabinet change: his faithful sister now had a home and family of her own and was no

[m] Special circular entitled "The BURBANK thirteen-acre Goldridge Experiment Farm. Inventory, January 1, 1924."

longer his chief adviser. Sentiment had to give way to realities. Fame he apparently took for granted — something already attained — but money had to be worked for, and no nonsense about it.

BURBANK's moral standards were such as had been impressed upon him by a strict father and an upright New England mother. To the best of his ability he observed all the rules of Decalogue. He was personally honest, paid his just debts, and honored and protected his widowed mother throughout her long life. All his life he abhorred drinking and carousing. He did not covet his neighbor's wife, and he was entirely free from philandering. But with all these convictions he was remarkably tolerant of other people's manner of life. One evidence of his perennially youthful mind was that he did not sour with age and disappointment — that is, not visibly. If anything, with changing times he became more tolerant but at the same time I am persuaded that he also became cynical. Faithless business associates and inconstant friends brought about this change in his fundamental makeup. During the last ten years of his life he had troubles enough to sear a man's brain; they continued up to the day of his passing, but through it all he retained his sense of humor. True to his New England heritage, he did not air his troubles. He pretended not to read, to hear or to see, but one who knew him well and was close to him tells me that "nothing that went on escaped him; that he was the most observant man and the quickest to draw conclusions" of any man he ever saw. Putting into practice his philosophy of life, he simply ignored what he could not help.

## XIV

## BURBANK'S RELIGION

IT MIGHT be said that BURBANK was a religious man without being a religionist. He respected christianity and liked to attend church services. Apparently he sought something in the church which he never could quite find. Brought up by church-going people — especially by a religious but liberal mother — it was only natural that he should feel the urge to observe some of the forms of religion. While he may have attended church partially from habit and because it was the thing to do, I am convinced that there was some deeper motive in his nature that impelled him to incline toward the church. His church attendance was not prompted by motives of social advancement or business prestige, and I have no evidence either that he went as a conventional worshiper. He certainly did not regard himself as a sinner in need of periodical cleansing. He was never humble and he was never meek and he was not a prayerful man. He liked to hear the scriptures expounded but the discourses were liable to leave him cold and discontented rather than ecstatic.

Then why did he go to church, at least at first, with considerable regularity? My explanation or guess is this: as a follower of DARWIN, his childhood's faith and belief had been upset and it required many, many years for him to acquire a philosophy to replace them. In the meantime he went as a matter of habit and to please his mother. As a young man in his teens and early twenties the thunders of disapproval against DARWIN from every pulpit in the land must have left him troubled in spirit, for there was a strong spiritual side to his makeup. Having fully accepted DARWIN's naturalistic explanation of the origin of species in the plant and animal world, as against the theistic origin taught by the church, he did not try to reconcile the two explanations of the source of life. Being a strong believer in organic evolution he accepted this teaching as his religion. At this point he might have become an out and out infidel, but he did not. Far from it. His childhood faith had been uprooted but, like the weeds in his garden, some of the remnants insisted upon growing again. All of the roots of his faith had not been destroyed; like the regenerated weeds, he did not cultivate them but they refused to die.

When he went to California he became a church attendant, joined the Baptist church and became, for a time at least, a regular communicant. But spiritually he was not satisfied. Actually he was in rebellion against the forms of the church rather than its substance. Creed and dogma he could not abide, and the oratorical

pyrotechnics of the old-time revivalist type of minister left him cold and disillusioned.[93] He craved a religion of brotherly love uncomplicated by tenets incapable of satisfactory proof. So he left the church he had been attending and became a follower of a "renegade" minister from the same church — Rev. J. WILLIAM HUDSON, who became a Unitarian. And this was the faith that he was nearest to for the rest of his life. He selected a Unitarian minister, the Rev. CALEB S. S. DUTTON, pastor of the First Unitarian Church of San Francisco, to officiate at his marriage in 1916, and this same man had a part in the memorial services in 1926 after he died. His old friend, H. W. SLATER, wrote at the time that "BURBANK was a Unitarian as was his father before him",[94] which, strictly speaking, was incorrect as neither formally belonged to that church.

[93] BURBANK evidently attended different churches when a young man. While details of events that transpired in the early eighties are now not always clear in the memories of persons yet living, those I have talked with are in substantial agreement—that he attended both the Baptist and Christian churches and later became identified with the Unitarian faith. Three versions are cited: Prof. J. E. CHENOWETH of Bakersfield, California, in a personal letter, writes under date of August 9, 1939:

"So far as the church situation was concerned in Santa Rosa, due to the lapse of time, my memory is a little hazy on one or two points. My own affiliation was with the First Christian Church, and at that time the pulpit presentations were very much of a 'Hell-fire-and-damnation' nature. Ranting and snorting were considered to be good forms. There was a change in the pastor, and the new man who came in was Reverend J. WILLIAM HUDSON. He was of a different type. He spoke of weaving the warp and woof in the pattern of life. He described the work of SAVONAROLA. He forgot to say very much about 'Hell-and-damnation'.

"As a consequence, the elders proposed a change of ministers. There was a schism in the church. A number of the congregation organized the second Christian Church, and it was to this group that I turned, while my mother remained in the original church. LUTHER BURBANK attended this church and he passed the collection plate down one aisle, while I passed one down the other.

"I still have a very vivid mental picture of LUTHER BURBANK and the manner in which he passed the collection basket. About that time I was graduated from high school and moved to San Francisco and J. WILLIAM HUDSON was called East to an important pastorate. So, it is quite possible that a Unitarian minister may have invited his attention as did the keen intellect and the brilliant presentations of the young J. WILLIAM HUDSON."

Dr. D. P. ANDERSON of Santa Rosa, in a personal letter under the date of August 11, 1939, states:

"As you probably know, BURBANK attended the Baptist Church—the one that had the famous building built from a single tree, a California redwood—when he first came to Santa Rosa. He quit it because of their narrow views and so did I. He never attended church after that except the Unitarian which sprang up under a Mr. HUDSON and disappeared when he left. I understand while not a member [that] BURBANK attended occasionally."

Senator HERBERT W. SLATER, a newspaper man of Santa Rosa, writes, September 2, 1939:

"Mr. Burbank of course was not an unbeliever. I heard him make declarations, long previous to the religious hubbub which sought to brand him as an unbeliever, in which he pronounced his belief in God. . . . I remember Mr. BURBANK used to attend, how often I don't know, the Peoples' Christian Church here, of which Dr. J. WILLIAM HUDSON was pastor after he had seceded from the First Christian Church."

[94] Santa Rosa Press-Democrat, Santa Rosa, California, April 11, 1926.

In a strict, ecclesiastical sense, BURBANK was not religious and not even a Christian but in the eyes of the world he was both. So far as I know, he made no attempt to classify his religious beliefs or convictions but others attempted to do so for him and he never rebuked them. However, it was mostly after his death that organized agnosticism came forward to claim him as its own, their last act being, to put on quite a "show" at his funeral.

Several months before his death a controversy arose regarding his religious beliefs. He gave an interview to a news writer[95] who branded him as an infidel. Later he delivered a lay sermon in the First Congregational Church in San Francisco[96] and attempted to clarify his ideas about religion, in which he outlined his philosophy of life; but this only made matters worse and he was denounced from pulpits throughout the land. Less than two months later he died and, according to an arrangement he had made two years previously, a prominent free-thinker, Judge B. B. LINDSEY, delivered the funeral oration and finally at the graveside WILBUR HALL read the famous eulogy that ROBERT G. INGERSOLL pronounced over the body of his brother in Washington, D. C. in 1879.[97] LINDSEY's address was published in pamphlet form[98] and widely circulated. Besides the address and how he came to deliver it (a pact between himself and BURBANK), the pamphlet contained an article by MAYNARD SHIPLEY, a militant agnostic, entitled "LUTHER BURBANK's Last Rites", and a statement by WALTER W. LIGGETT (evidently a free-thinker propagandist), entitled "Baptists Lie About LUTHER BURBANK."

SHIPLEY thus described his arrival at the burial scene beneath the spreading branches of a cedar of Lebanon tree in the BURBANK yard: "Save for a few minutes only, at the moment of greeting, there was an entire absence of gloom. Voices broke for an instant, it is true; but there was no funereal atmosphere; no black crepe or black dress was in the house; there were no sepulchral tones, no sobs. Mrs. BURBANK was dressed in a light striped material; her friend and companion, Miss GLADYS KENNEY, wore white." A perfect infidel's funeral carried out to the last detail in the best Ingersollian style. Obviously planned and executed by experts with an eye to the cause! WILBUR HALL, "an old friend of the family" and BURBANK's biographer, "was in charge of the private services" at the graveside. LINDSEY denies all knowledge[99] of the nature of the burial service that was to be held so it must be concluded that BURBANK did not plan it as he did the funeral oration.

[95] EDGAR WAITE, San Francisco Bulletin, January 22, 1926.

[96] San Francisco Bulletin, February 1, 1926.

[97] Santa Rosa Press-Democrat, Santa Rosa, California, April 15, 1926.

[98] "Address at the Grave of LUTHER BURBANK", by Judge BEN B. LINDSEY. Little Blue Book No. 724, Haldeman-Julius Publications, Girard, Kansas.

[99] Personal letter to the author, December 18, 1939.

The burden of Mr. LIGGETT's contribution was a refutation of an editorial published in a religious journal [100] to the effect that BURBANK recanted on his death bed. He faithfully ran down the story and submitted proof that there was nothing to it.

Although a practical Christian and leading a Christian life, BURBANK was not an orthodox Christian. In playful mood he may have referred to himself as an infidel or even as a pagan but such remarks must not be taken too seriously as he was given to making extravagant statements. As he grew older he devised a philosophy of life that was all his own. His code of morals was all that any churchman could ask for. He was not opposed to the church and never tried to tear it down. If he did not believe in it he certainly was not in the least a propagandist against the faith — was far from being a militant agnostic. As a matter of fact, he had no grievances against the church itself but against what he considered its narrowness and intolerance. Morally speaking he led a blameless life. Few men came as near to observing the Ten Commandments. A teetotaler by choice and conviction all his life he preached against the use of tobacco and spirituous liquors. Absurdly enough, during the religious controversy, a handful of fanatics in the Sonoma County Women's Christian Temperance Union, of which he was an honorary life member, tried to humiliate him by requesting his presence at a mass meeting called for the purpose of praying for his soul.[101] He sent his regrets but the incongruity of the situation appealed to his sense of humor and caused him many a wry smile.

To preach against the use of alcoholic beverages in a community where wine-making was a major industry required considerable courage but he could not compromise on matters of principle. Still, on occasion, he could laugh at himself. A story is told [102] that when approaching his seventy-fifth birthday, in waggish mood, he boasted that he would celebrate his natal day by taking his first drink of wine, remarking that he "guessed he was too old to acquire the habit." But alas, he was slightly ill that day and did not feel like carrying out his little joke. Too bad the reporters did not hear of the incident or they would have made him go through with it to the accompaniment of clinking glasses and clicking cameras — even though it killed him — as the story would have been good for several columns at so-many dollars per, and perhaps a promotion for the enterprising newsmen — for this was the manner in which he was exploited by space writers.

At this point I feel justified in interjecting a mention of what might be termed a morbid confession story, by a troubled soul, that appeared in a popular magazine a few years ago. The story was entitled "Murder by Print. LUTHER BURBANK's death through a newspaper-made mass hysteria." The author [103] convicts himself

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[100] The Crusaders' Champion, June 11, 1926.
[101] San Francisco Bulletin, February 26 and 27, 1926.
[102] Related to the author by Mrs. BURBANK in 1932.
[103] FRANK PIAZZI, Coronet, pp. 170-172, May, 1937.

of being one of the "murderers." He tells about living across the street from the BURBANK garden and throughout his childhood knowing BURBANK by sight. As a high school boy he became acquainted with BURBANK and was the recipient of many kindnesses at his hands. After finishing school PIAZZI became a reporter for a local paper and at the same time served as correspondent for the United Press. In the latter capacity he was asked by the *Oakland Post-Enquirer* to interview BURBANK "on his beliefs on immortality and the hereafter" to be used "as a companion piece to a similar interview with HENRY FORD then appearing in the *Cosmopolitan Magazine*."

"To my questions he gave simple, clear, interesting answers." The story appeared next day and was picked up by the service wires and broadcast throughout the nation. The mail deluge came a few days later. Other correspondents, with cameramen, arrived daily. Then he delivered his fateful address in a San Francisco church and tried to explain, but the newspapers branded him as an atheist. "Here was a highly controversial topic, one good for weeks of headline exploitation, with an international figure in the spotlight. . . . Editors incited the riot. The journalistic pack had got the scent. And LUTHER BURBANK was the harried prey. . . . His telephone rang night and day. Reporters camped on his doorstep. Telegrams poured in. The mail increased horrifyingly.

"He was questioned, accused, villified, libeled, lampooned, and execrated. One city editor forced me, under violent protest, to go and ask the poor plant man if he ever got down on his knees and prayed to God. BURBANK's answer — I shook his hand when he told me it — was: 'Tell him it's none of his damned business.' Public opinion, fanned by sensation seeking papers, turned against him. He suffered a breakdown. He was confined to his bed under the care of a doctor. No one could see him. This, climaxing the crescendo of hysteria that had swept the nation following his pulpit address, was like an inevitable third act. The newspapers and the wire news services waited breathlessly for every bulletin as Mr. BURBANK's life hung precariously in the balance. Thirteen minutes after midnight, April 11, 1926, LUTHER BURBANK died — victim of a chance phrase publicized by the American Press."

If BURBANK was an infidel he certainly was not proud of it. In his wildest statements he never condemned the biblical characters nor the Bible as a whole as being an unfit document for children to read. Neither did he condemn the church as an organization. Possibly he looked upon it as a moral institution only — a guide for the living but not something to die by. He believed in intellectual freedom but certainly no one has reported that he ever expressed admiration or even tolerance of free love or trial marriage. He would have regarded both of these practices as highly immoral.

Could he have been an infidel and still retain his moral code? I do not think so. I think he was frankly skeptical regarding the Bible story and all its pronouncements and preferred to accept the

naturalistic explanation of life as his guide. But beyond this he did not go as he was not a profound logician, was not schooled in formal philosophy, and was not especially well read in any direction if one is to judge by the books in his personal library, except the works of CHARLES DARWIN — *Origin of Species, Animals and Plants Under Domestication,* and *Cross and Self-Fertilization,* together with the standard books on taxonomic botany of his time. These latter however were mostly books of reference.

According to BURBANK's historian,[104] a somewhat biased witness — biased in favor of classifying him as an infidel — who spent a few months with BURBANK just previous to his death, says of him: "LUTHER BURBANK believed neither in heaven nor in hell, in the transmigration of souls nor the translation of the body. . . . For him the 'life everlasting' was a phrase — a figure of speech. He had as little curiosity about the unknowable as any man who ever lived, and considerably less concern with the future. For him life overflowed with wonder, beauty, delight, and the work he found committed to his hand, and whether anything was to go on for him or not interested him not a whit. Sufficient unto the day was the heaven thereof."

On the other side of the ledger we have the writings of HARWOOD,[105] CLAMPETT [106] and his own ghost-written book.[107] They all spread the mantle of Christian charity over him and accepted him as a religious man of a special variety. HARWOOD gives this as BURBANK's creed: "My theory of the laws and underlying principles of plant creation is, in many respects, diametrically opposed to the theories of the materialists. I am a sincere believer in a higher power than that of man. All my investigations have led me away from the idea of a dead, material universe, tossed about by various forces, to that of a universe which is all-force, life, soul, thought, or whatever name we may choose to call it. Every atom, molecule, plant, animal, or planet is only an aggregation of organized unit forces held in place by stronger forces, thus holding them for a time latent, though teeming with inconceivable power. All life on our planet is, so to speak, just on the fringe of this infinite ocean of force. The universe is not half dead, but all alive." If this was written by BURBANK, and I think it was, it bears a striking resemblance to the views of THOMAS A. EDISON, the inventor, expressed a few years before on the same subject.[108] "I believe our bodies are composed of myriads and myriads of infinitesimal entities, each in itself a unit of life, which band together to build a

[104] WILBUR HALL.

[105] HARWOOD, W. S., BURBANK's Creed. Century Magazine, New York, April, 1905.

[106] CLAMPETT, FREDERICK WILLIAM, LUTHER BURBANK, Our Beloved Infidel; His Religion of Humanity. Macmillan Company, New York, 1926.

[107] Summarized in a little book, "My Beliefs—LUTHER BURBANK," with an appreciation by CHARLES F. RIDEAL, who apparently was the ghost writer although some of the statements are undoubtedly BURBANK's. The Avondale Press, New York. No date.

[108] LESCARBURA, AUSTIN C., EDISON's views on life and death. Scientific Monthly, October 30, 1921.

man. . . . The entities are life. . . . The entities live forever. You cannot destroy them, just as you cannot destroy matter. . . . What we call death is simply a departure of the entities from our body." BURBANK was a great admirer of EDISON and perhaps a bit envious because, while both were "wizards" in their own right, EDISON was accepted without reservation as a scientist while BURBANK was not. EDISON visited BURBANK in Santa Rosa in 1915, and they were much photographed together and EDISON paid him many heart-warming compliments. It is quite conceivable that he used EDISON's thoughts to describe his own state of mind. He was not averse to allowing others to do his phrasing for him as he wrote with difficulty on abstruse subjects.

BURBANK must have seen the interviews given by EDISON on his religious beliefs as they appeared in *Cosmopolitan Magazine* May 20, 1920, as well as in *Scientific Monthly* for October 30, 1920, and Freethinker organizations gave them much publicity.

CLAMPETT is even more vague in his assertions but with skillful strokes he paints a picture of the Christlike qualities of BURBANK without committing himself specifically as to his religious beliefs.

Both CLAMPETT and HARWOOD, as churchmen and BURBANK historians, seemed to feel it incumbent upon themselves to play up their man as a Christian character. From their viewpoint, no other part would suit him as they were portraying him as a kind of mystical hero with super-human attributes and their appeal was to the lovers of the beautiful and worshipers of the wonderful.

CLAMPETT stressed BURBANK's affection for children and his universal love of humanity. Here he was on safe ground as BURBANK was a veritable Santa Claus to the school children of his town and he was never too busy or too preoccupied to speak a kind word to every tot that came his way.

In his helplessness and exasperation at trying to explain his position to the howling multitude of fanatics during the religious controversy and realizing the futility of trying to reason with unreasonable beings, he fell back upon what was to him his last line of defense — repeating over and over what he had said before: "I love everybody; I love everything. I love humanity; it has been a constant delight during all my years of life; I love flowers, trees, animals, and all the works of nature."[109]

Being desirous of learning what churchmen in general think of BURBANK, clergymen of sufficient note to be included in *Who's Who in America* were contacted throughout the United States and asked several questions, one of which touched on his religious beliefs. The following excerpts are culled from the mass of replies:

"Held mystic views. Believe him to be an agnostic."

"Held practical views. Believed in God and much of the Christian teaching."

"Deeply regret that he lost the spiritual vision [which he] held in former years."

[109] See Footnote 107.

"Reports that he was a non-believer [were] never properly confirmed. Deplorable if true."

"No matter what may have been his religious convictions, he left a fine legacy of temporal blessings."

"Would have been twice as valuable to science if he had believed in God."

"Was quite unorthodox; declined to accept things as they are and went out to make them as they ought to be, as he saw it."

"A naturalist in religion; not conscious of revealed religion."

"Sorry [that] statements regarding his lack of faith have gone abroad, for he could not have done what he did if he had not believed in God as the author of law in the natural world."

All of these men knew BURBANK only by reputation which they gained by reading "books, magazines, and newspapers." Most of them seemed to be well posted on the religious controversy that raged in 1926 but only two or three, from centers of Fundamentalism, evidenced any signs of bitterness. The majority frankly regarded him as a skeptic, some cheerfully, others regretfully, a few with scorn. Home folks, that is, residents of Santa Rosa, who were acquainted with his idiosyncrasies refused to believe that he was irreligious despite anything he might say. This might be attributed to wishful thinking but it is more likely that his daily life was a refutation of his own words. Here is the way the situation is summed up by the Rev. THOMAS BEVERLY MARSH,[110] pastor of the First Baptist Church of Santa Rosa, who never saw BURBANK, was a comparative stranger in the town, and therefore had to depend upon what people there told him when he made extensive inquiries:

> Mr. BURBANK was not a member of the Baptist Church, but he was known by those who were closest to his life as a very religious man. He had a kindly interest in the various churches of the community, and he was devout in his personal life. During the later years of his life, his interest in horticultural experiments appeared to engross his attention and, owing to this, his attendance at church services grew less frequent.
>
> His personal friends in Santa Rosa regret very much the publicity given to a statement he made to the press regarding his belief in Immortality. They feel that this casual statement of a recognized expert in one department of science in another realm (that of Religion where he did not pose as an expert) has been magnified out of all proportion to its importance in the mind of Mr. BURBANK. His friends here seem to be quite persuaded that he retained his religious convictions to the end.

Finally, BURBANK undoubtedly led a Christian life according to the standards of the multitude but with equal certainty he did not practice the forms or ceremonials of religion. He could be claimed both by the pro's and the con's. In fairness it should be stated that he did not claim to be an "all out" believer in the Bible as a piece of inspired literature — in fact, he rejected the idea — but he never went out of his way to attack the faith of others. His quoted sayings about religion are of little value in arriving at the truth of his convictions, because it is sad but true that his self-assurance led him to talk too much about things that he knew little about. Since he was extravagant of speech, a chance remark might be expanded into a sensational story. And he loved this sort of publicity, at least until it got out of bounds.

[110] Personal letter to the author, September 26, 1939.

It is too bad that he did not write a connected, authentic account of his life. Unfortunately there were only too many persons ready and willing to take the job off his hands, and being an extremely busy man he let them do it, well knowing that they would go the limit and say things that he would not say himself, and in more catchy phrasing than he was capable of employing; and I have no evidence that he ever protested their statements. Reason, he loved hyperbole and exaggeration. But with all his goodness of living he was a skeptic and had his honest doubts about the Bible story.

## XV

## BURBANK'S FORAY INTO SCIENCE — THE CARNEGIE GRANT

FOR A TIME, in his middle fifties, BURBANK became a conventional scientist in spite of himself. This brief incursion into a new manner of life — to him a sort of regimented existence — occurred in 1905 when the Carnegie Institution of Washington decided to provide him with a cash subsidy in the belief that valuable information on the science of plant breeding was being lost because he, working alone, was unable to keep careful record of what he was doing. More than once he had complained that State and Federal agencies were expending large sums on research while he was left to run a private experiment station that benefited the public far more than it did himself. He said it was unfair but did nothing further about it. As usual, though, his friends sprang to his aid. They soon learned, however, that under existing laws and regulations, public funds, State and Federal, could not be used to support a private enterprise, no matter how meritorious it might be. Then they began to look for a private benefactor.

About this time the Carnegie Institution was very much in the public eye. Founded by ANDREW CARNEGIE in 1902, it was reincorporated by an act of Congress in April of 1904. The initial endowment by CARNEGIE amounted to $10,000,000 but later this sum was more than doubled. It was declared that "the objects of the corporation shall be to encourage in the broadest and most liberal manner, investigation, research and discovery and the application of knowledge to the improvement of mankind." [111] Provision was made for a Board of Trustees (not less than 27 nor more than 30) which was given power to elect officers from its membership and to exercise complete management and control of the activities and affairs of the Institution.

Mr. CARNEGIE himself named the first Board of Trustees and while a great majority of the members were residents of the extreme eastern part of the United States at least four were former residents of California or had a sentimental interest in that state. Three of them, by virtue of their position on the Board, wielded great influence on the policies of the Institution. DANIEL C. GILMAN, President of the Institution and Chairman of the Executive Committee of the Board of Trustees, an early President of the University of California, had lived in that state for three years; D. O. MILLS, a pioneer banker and merchant of San Francisco, was an influential member of the Finance Committee (later chairman);

[111] Year Book No. 1, 1902, Carnegie Institution, Washington, D. C.

and Judge WILLIAM W. MORROW, for twenty-seven years a member of the Board of Trustees, lived for many years in Santa Rosa and was married there. LYMAN J. GAGE, ex-Secretary of the Treasury, was a member of the Finance Committee and, while not originally hailing from California, may have had more than a passing interest in the state as evidenced by his going to San Diego (in 1909) to be married and making the place his home for eighteen years thereafter.

As early as 1904 the Carnegie Institution was widely known for its large endowment and generous benefactions to science. It was perfectly logical that BURBANK's friends, after failing to obtain financial assistance from public funds, should turn to this new dispenser of largess. The story of how, or by whom, BURBANK's case was brought to the attention of the Trustees of the Institution never has been told, but it was common rumor at the time that "California should have its share" of any moneys that might be available for the assistance of struggling men of science and that great pressure to this end was being brought to bear upon the Trustees by "the California members" and others. And they were successful in being heard. The Institution voted BURBANK a cash subsidy of $10,000 a year. This action brought a storm of protest from institutional scientists. They criticised the Carnegie Institution on the ground that BURBANK was not a scientist and that he could show no scientific results from his experiments.

In response to this criticism the Institution promised to send a competent man to collaborate with BURBANK and see that he kept faithful records and followed conventional methods of procedure. The first installment of $10,000 was given to BURBANK in 1905, but a year or more elapsed before a satisfactory person could be found to supervise the project.

At the end of the fiscal year, October 31, 1905, formal reports on all projects receiving subsidies from the Foundation were required. BURBANK's project for the period, "Grant No. 221," appears to have been duly reported on, but must have been re-written as the discussion does not sound like BURBANK at all, although the claims as to numbers of plants involved are truly Burbankian. The report, as published, follows:[113]

"The experiments under way are the most extensive ever carried out, but from their very nature valuable results, either practical or scientific, can not be obtained at once. The pursuit of long periods of intensely careful and most accurate observations on a broad and comprehensive scale is the only course whereby results which will stand the test of time may be obtained. The laboratory and small field experiments of the past have never included enough species under study at the same time, and it has been impossible to draw general conclusions safely, as the different tribes and species of plants have each a slightly different story to relate. Very strong points are brought out by studying the results of these vast experi-

[113] Carnegie Institution of Washington, Year Book No. 4, p. 125, 1905.

ments, and much valuable material for thought will undoubtedly be found in the scientific account of the experiments.

"Some of the experiments which have been carried on for the last 15 to 38 years are just coming to fruition. A partial list of the plants upon which work is now progressing includes 300,000 new hybrid plums, the work of the past 25 years in crossing about every known species, and about 10,000 seedlings of the year's growth; 10,000 new apples; many thousand peach and peach-nectarine crosses; 8,000 new seedlings of pineapple quince; 400 new cherry seedlings; 1,000 new grapevines; 8,000 new hybrid chestnuts, crosses of American, Japanese, Chinese, and Italian species; 800 new and distinct hybrid walnuts, crosses of American black, Sieboldi, English, Manchuria, butternut, and others; many thousand apricots and plumcots; 5,000 select, improved, thornless 'Goumi' (Eleagnus) bushes; very numerous other fruits in less numbers, and 10,000 new, rare, hybrid seedling potatoes.

"For the past eight years Opuntias and other cacti have been secured from all parts of the world. Selections have been made and crossed and thousands of hybrid seedlings raised, some tender or hardy or gigantic or dwarf; some bearing gigantic fruits in profusion and other small ones of exquisite flavor. Some large groups have been developed which produce enormous quantities of nutritious food for all kinds of stock and poultry. This work promises well for science and economics. Perhaps the next in importance are the experiments on grasses and forage plants. Some new ones of great value are being produced and some of rare scientific value in the study of heredity and variation."

It is evident that the BURBANK cause had been thoroughly sold to the Institution and great things were expected from the venture. In commenting upon the activities of the Foundation for the year, President WOODWARD (who succeeded GILMAN in 1904) said, with reference to Grant No. 221:

"The horticultural experiments and the remarkable achievements of Mr. LUTHER BURBANK are well known in a popular way, though it must be said that the more important aspects of his work remain yet to be interpreted to men of science as well as to the interested public. Owing to the impracticability, during the past year, of securing the services of a trained biologist, the preparation of a scientific account of the ways, means, methods, and results of Mr. BURBANK's work has been delayed. He has continued his experiments, however, as related in his report, and it is hoped that the necessary arrangements for securing the scientific account of his work contemplated by the Board of Trustees will not be long deferred. *Little short of five years will be required for this work if it is done thoroughly well.*"

The italics are mine. The sentence deserves emphasis because those seventeen words constitute the only reference I have been able to find that mentioned any specific period the benefaction was expected to run. The President was a man of science and therefore cautious. He doubtless thought, even hoped—if he allowed

his imagination to dwell on the possibilities as represented to him—that the project might run for a long time, but could see no reason for committing himself beyond a modest period of years.

The next formal report on the BURBANK project,[113] designated as "Grant No. 310, Experiments in Plant Development," bears evidence of having been edited but some of BURBANK's personality remains. He undoubtedly had more to say about the earthquake than is printed as it was true that the small greenhouse was uninjured while the wooden residence only a few feet away was badly cracked and the chimney thrown down. The incident was much commented upon at the time. The fact that he suffered some property damage while his extensive experimental work came off scatheless appeared, to the sentimentally inclined, to be miraculous and further strengthened their belief in his being a superman. Here is the report, as published:

"Most strangely and most fortunately the great earthquake of April 18, 1906, which leveled the whole business section of this city [Santa Rosa] in a few seconds, did no damage whatever to the greenhouse or to any of the plants.

"The work of crossing and continual selection of promising variations continues as before, and an unusual number of new species and varieties of wild and locally known plants have been received and are being carefully inspected for characters of value either for economic or scientific purposes. Five hundred and twenty-two native species and varieties were received from native collectors in South America, 241 from Australia and New Zealand, and nearly 200 from various other parts of the world, among them many promising new types of Solanums, Opuntias, native wild fruits and vegetables, locally known and medicinal plants, trees, shrubs, and flowers, nearly all from seeds, thus obviating danger of insect pests and greatly lessening the expense and giving a better opportunity for selection by having greater numbers. . . . Great progress is being made with the Opuntias, plums, nuts, and berries, among all of which unequaled opportunities for the study of scientific laws and principles have developed."

Editorial comment by President WOODWARD follows:[114]

"Mr. BURBANK reports that the year just passed has proved very successful for the extensive experiments and investigations in plant, fruit, and flower development carried on by him thru aid granted by the Institution. By great good fortune the earthquake which proved so destructive to the city of Santa Rosa in which he lives and to the surrounding country, did very little damage to his property. In one respect, doubtless, the earthquake was advantageous to him and his work, namely, in preventing visitors from encroaching too freely on his time and attention.

"Thru the agency of a committee, consisting of the President, as chairman, and of Messrs. C. B. DAVENPORT (Director of Experi-

[113] *Ibid.*, Year Book No. 5, p. 125, 1906.
[114] *Ibid.*, Year Book No. 5, p. 24, 1906.

mental Evolution), D. T. MACDOUGAL (Director of Botanical Research), and A. G. MAYER (Director of Marine Biology), heads of the departments of biological research, the task of preparing a scientific account of the ways, means, and methods employed by Mr. BURBANK in his unrivaled work has been undertaken during the year. In May last all members of this committee except Dr. MAYER visited Santa Rosa and conferred with Mr. BURBANK in order to develop a program for this undertaking. In accordance with this program, the details of which need not be stated here, Dr. GEORGE H. SHULL, of the staff of the Department of Experimental Evolution, spent a portion of the summer in work at Santa Rosa, and he has recently returned thither to resume his labors. It is contemplated to have Dr. SHULL spend parts of two or three years at work with Mr. BURBANK, and to call to our aid also the services of other specialists of the departments of biological research.

"Although space forbids a further account of this work here, the President desires to record his warm esteem of the scientific spirit of cooperation shown in this enterprise by Mr. BURBANK, by the members of the committee, by Dr. SHULL, and by numerous colleagues whose counsel has been sought. By means of the cooperation thus secured it is confidently believed that the diverse scientific and economic ends in view may be achieved in ways which will commend themselves alike to the Institution and to the general public."

BURBANK's next report,[115] for the year 1907, bears evidence of having been condensed and much edited but it still is BURBANK's, not SHULL's, who was now on the job as "collaborator." All of BURBANK's unsupported statements and claims of having produced new species, and the number of separate species and total number of plants under observation, are still accepted at face value. The report is reproduced in full, as published:

"Within the limits of this annual report Mr. BURBANK finds it possible to give only a brief account of his experiments and operations in plant improvement. This work, which has engaged his attention for the past 39 years, is of steadily growing interest, and its cumulative results are more evident than ever before. He has now under experimental test over 3,600 distinct species of plants, and many thousand varieties of some of these. Over a million seedling plants are raised each year for selection and for the study of variation from the effects of crossing. The newly developed fruit and fodder plants are attracting great interest—not only in the United States, but in many foreign countries. New species have been established which go on their way with the same unchanging precision of typical characters as do any of the species established in the past by nature.

"One of the interesting recent results is the production of a distinct new species of Solanum (*S. burbanki*) by crossing *S. guineense* var., a native of central West Africa, with *S. villosum*,

[115] *Ibid.*, Year Book No. 6, pp. 176-177, 1907.

of Chile. The experiments leading to this new species were begun in 1895. From the cross-bred seeds numerous plants were grown in the early part of the season of 1896, all practically alike. Another generation of numerous individuals was brought into fruit the latter part of 1896, this third generation embracing some 2,000 individuals, all as much alike as if raised from any wild, fixed species. In 1907 the fourth and fifth generations have been produced, and among 30,000 plants, which have flowered and ripened abundantly, no variation toward either parent, or in any other direction, has occurred, and this new hybrid may therefore be classed as a distinct new species. *Solanum guineense* is a strong, bushy perennial bearing large quantities of black fruits of most unpleasant qualities; *S. villosum* is a dwarf, procumbent annual, which produces abundant clusters of small, hard, green berries, but the fruit of the new species is delicious, resembling the low-bush blueberry of the Eastern States, *Vaccinium pennsylvanicum,* in color, flavor, consistency, and general appearance. The species is grown with ease and will probably prove to be of great commercial value.

"Extensive experiments of extreme interest and importance have been conducted with *Zea Mays,* the common corn. This annual grass is evidently a native of America, but has not within historic times been found wild, the grass-like plant teosinte of Central America being its nearest wild relative. Like all other grasses, the kernels of the progenitors of *Zea Mays* many years ago no doubt grew at the top of the stalk, like sugar-cane, wheat, barley, etc. By these experiments the plant has been carried back, through many forms, to the original simple grass. It has also been crossed with teosinte. Numerous photographs, showing the strange ancestral forms, have been obtained, and it is hoped that the experiments, which are of especial importance to biologists, may be extended through another year.

"The new giant Opuntias so far produced will endure only about the same degree of freezing as the fig or eucalyptus trees. An effort is being made to produce hardy varieties which, it is hoped, can be cultivated successfully in more northern climates.

"Dr. GEORGE H. SHULL has taken notes on Mr. BURBANK's experiments and has made much progress, but new results of past experiments are accruing very rapidly, and additional trained scientific observers could be usefully employed upon this work.

"Dr. W. A. CANNON, of the Desert Botanical Laboratory, has under microscopical examination several of Mr. BURBANK's hybrids, and other hybrids are being studied by Professor WEBBER of Cornell University."

President WOODWARD continued to be hopeful. Dr. SHULL was busy trying to cull useful information from BURBANK's old records and no doubt had in hand an account of his current activities but of necessity, at this stage, was not yet well enough informed to justify a protest against publishing all of BURBANK's statements and claims in his reports, essentially as written. He, however, must

have said something as the President was noticeably more cautious in his editorial comments in the 1907 report. It must have startled the President of the Institution to learn that BURBANK's experiments, which had been heralded to him in such laudatory terms, were often uncontrolled and his records meager.

Yes, there had been a grave misunderstanding. BURBANK thought he was being subsidized to enable him to gather together more plants so that he could make more wholesale crosses, and the President and Trustees of the Carnegie Institution assumed that BURBANK's numerous experiments had been conducted in the usual manner—with checks, controls, and elementary safeguards for insuring the purity of his hybrids so that their parentage would be known and, finally, that surely he had enough random notes to make it possible to chart the heredity of some of his complicated crosses.

The awakening, on both sides, was not pleasant. As the cold eye of science began to view the situation, the over-inflated balloon of possibilities began to shrivel. BURBANK's enthusiastic friends—with the best of intentions—had misrepresented the case. BURBANK's popular reputation was so great and his spokesman so insistent, that the Institution, apparently, had yielded to the pressure and voted a subsidy without making the usual careful examination into the merits of the request — or demand — for assistance.

SHULL found himself in a difficult position. In accepting the appointment as collaborator, he had, to a certain extent, staked his reputation as a scientist on the results of the BURBANK studies. A modern geneticist and a scientist of the purest type, SHULL could not be expected to have much sympathy with the primary aims of BURBANK. On the other hand, BURBANK had only an inkling of SHULL's ideals. Add to this BURBANK's independence and self-esteem and we have a perfect setup for a clash of wills. But both had much to lose by being stubborn—one a reputation, the other a large sum of much-needed money and the prospect of being received irrevocably into the ranks of science. And it is much to the credit of both that they did labor together for nearly five years. SHULL, especially, deserves a bouquet for BURBANK was known to be a difficult man to work with, particularly if it became necessary to oppose him or in any way to direct his activities; and SHULL had to do both of these things. What success he had was due to the exercise of tact, perseverance, and patience. Musing on this period more than 30 years later SHULL remarks:[116] "I learned from the start that my problem was chiefly a psychological one."

President WOODWARD commented briefly on BURBANK's report for 1907:[117] "The experiments and investigations of Mr. BURBANK and the work of preparing a scientific account of his methods and achievements are progressing as favorably as the available division of time and labor will permit. Being necessarily and properly very

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[116] Letter to the author, November 25, 1939.

[117] *Ibid.*, Year Book No. 6, p. 27, 1907.

busy with his own affairs and overburdened by importunities of the public, the amount of time available for conference concerning the origin and the history of his productions is limited.

"Dr. SHULL, of the staff of the Department of Experimental Evolution, who is collecting the data for the account just referred to, has been at Santa Rosa for two series of conferences during the year, and plans to spend a portion of each year there until this work is completed. Dr. CANNON, of the Department of Botanical Research, has also spent a portion of the year at Santa Rosa, studying especially the physiology of some of the numerous hybrids developed by Mr. BURBANK.

"One of the most important results which may be expected to arise from Mr. BURBANK's work and from the interest in it taken by the Institution is a general stimulus to scientific horticulture. That contemporary society is ready to appreciate and utilize such a stimulus is a noteworthy sign of the times. Thus, many individual and governmental enterprises are giving attention to the economic advantages to be gained from rationally conducted experiments in this field, while biologists in increasing numbers are devoting their studies to the more recondite laws which govern plant, fruit, and flower developments."

BURBANK's report for the year 1908, which seems to have been his last one—at least the last one to be published in the Year Book, appears under the title, "Grant No. 483, Experiments in Plant Development,"[118] and looks to have been edited down to two paragraphs, though he must have written much more: "Experiments on Mr. BURBANK's plantation have been carried on with vigor and have been greatly increased in extent. The work on the cactus has interested numerous foreign governments and some of them are now growing the new cacti lately developed on Mr. BURBANK's grounds. These plants are grown without care, culture, or fertilizer, and on hard dry ground, without water, yet the average 3-year-old plant yields over 50 pounds of delicious fruit. The work is well advanced toward making a more hardy species and thus extending the culture to colder quarters of the globe. Mr. BURBANK also hopes to bring about a still further productiveness in the cacti, as well as a better chemical composition for the plant, and fruit of various colors, flavors, sizes, and seasons.

"A new series of thornless blackberries, with unique qualities, has been developed and many improvements have been made in plums, prunes, peaches, nectarines, apricots, quinces, plumcots, cherries, raspberries, and numerous other fruits. New forage plants, new roses, bulbous plants, ornamental, nut, and forest trees, and field crops have been grown, and several collectors are employed in securing seeds of wild plants from remote sections of the earth."

The President now seemed to realize that he had been grasping at intangibles—that the BURBANK project was becoming vexa-

[118] *Ibid.*, Year Book No. 7, p. 183, 1908.

tious, and from the viewpoint of the Institution less fertile of results than had been anticipated; in short, that he had been imposed upon by the BURBANK boosters. SHULL had been disillusioned for some time, I believe, but stuck doggedly to his task of trying to keep on amicable terms with BURBANK — who was highly nervous, on account of what to him was unwarranted interference with his manner of life—and still salvage what he could from his impossible task.

From 1908 to 1909 onward, embarrassments began to pile up. The Institution was still under fire by entrenched scientists who wanted the benefaction terminated; unrestricted speculation in "spineless cactus" was becoming a scandal; the controversy over the Wonderberry—a BURBANK production—was raging in the press, and the captious were saying to the Carnegie people, "We told you so."

I have no direct information regarding President WOODWARD's reactions to the outcome of the project but it is only reasonable to suppose that he was both embarrassed and humiliated at the debacle. How to ease out of the commitment and preserve the dignity and prestige of the Institution he represented was the problem. He could not very well tell the world that he and his Board of Trustees had been imposed upon, for some of the trustees who presumably were most active in making the commitment were still on the Board and might still be unconvinced that BURBANK was not worthy of their support.

While it had been rumored that it was the California members of the Board who had been instrumental in having BURBANK approved for a benefaction, this view cannot be literally true, as none of the members at the time claimed that state as their residence but, as pointed out earlier, three of them had lived there previous to 1905 and conceivably might have had a partisan interest in doing something for the state. Also, which is more probable, they may have been the instruments through which California admirers of BURBANK worked to have him recognized.

Dr. GILMAN died in 1908 and D. O. MILLS in 1909, but Judge MORROW, the former Santa Rosan, was an active member of the Board until his death in 1927. If former Californians exerted the influence they are credited with, it is highly probable that only two men were involved—MILLS and MORROW, neither of them men of science and therefore most likely to have had their interest aroused through sentiment, state pride, and popular clamor.

Here are President WOODWARD's observations on BURBANK's report for 1908.[119] They are brief and must have been inscribed in the bitterness of disillusion:

"As explained in previous reports, Dr. G. H. SHULL of the departmental staff, has in preparation a scientific account of the horticultural methods and products of LUTHER BURBANK. In conformity with the plan adopted by the committee (consisting of the

[119] *Ibid.*, Year Book No. 7, p. 27, 1908.

heads of departments of biological research and the President) having charge of this work, Dr. SHULL was sent abroad in August of this year for the purpose of visiting the principal horticultural establishments of Europe. By aid of this opportunity it is hoped that Dr. SHULL may not only become better qualified to place the aspects of Mr. BURBANK's work in their proper relations, but that he may also gain knowledge of value in the conduct of his own experiments in plant-breeding carried on at Cold Spring Harbor."

The benefaction was not discontinued at once, as the records of the Institution show that BURBANK was paid $10,000 each year from 1905 to 1909, inclusive, a total of $50,000.

The remaining references to BURBANK are very brief. Under "Departmental Reports for the year ending October 31, 1908, Department of Experimental Evolution, Breeding Strains of Plants", it is noted that "Dr. GEORGE H. SHULL, although occupied during much of the year (from February 15 to May 30) with his study of Mr. BURBANK's horticultural methods and results, has been able to continue most of the strains listed in last year's report. . . . On August 14 he started on a tour of the principal plant-breeding establishments of Europe." And again at the end of the year 1913, President WOODWARD explained, "the exigencies of his experimental work going forward at the departmental station have prevented Dr. SHULL from completing the manuscript of his account of the work of LUTHER BURBANK. It has been arranged, therefore, that he shall spend some months abroad, beginning with October, 1913, in order that uninterrupted attention to this manuscript may enable him to finish it without undue delay."

The next year, 1914, in his annual report, the President disposes of the BURBANK episode in a single sentence, sandwiched in among comments on other activities, by observing that "Dr. SHULL, of the departmental staff, spent the year in Berlin preparing his account of the horticultural work of LUTHER BURBANK." Just that and nothing more. The report never has been published. As a matter of fact, Dr. SHULL tells me that it is not yet finished. He says the Institution was under no obligation to publish a report which, undoubtedly, was true but, nevertheless, it was only a reasonable assumption for the public to expect one, as that would have been following normal procedure. What the public did not know, apparently, was that from the beginning there had been an understanding between SHULL and the Institution that nothing would be published during BURBANK's lifetime. This, no doubt, was considered to be a necessary precaution because intimate acquaintance with BURBANK might render it difficult, if not impossible, to discuss his work with that degree of candor demanded in a scientific report. Unfortunately, the motive involved — sparing BURBANK's feelings — could not be given publicity, thus creating an air of mystery and misunderstanding.

Failure to give an account of SHULL's five years' study opened the door to rumors and speculation. One group of partisans declared, in view of the attacks that had been made on BURBANK

by representatives of science, that the Institution dared not publish the facts lest he be vindicated, while the opposite camp wishfully concluded nothing had been found that was worth publishing — that BURBANK was a dud, a false alarm.

Without any explanation of the findings from a project on which the Institution had expended from fifty to seventy-five thousand dollars, it was assumed by a neutral public that results had not come up to expectations. Possibly the public never understood precisely what SHULL was instructed to do. He has told me lately that "the Carnegie Institution accomplished what it set out to do and was neither surprised nor disappointed in the results. . . . It was a fact-finding commission and I believe was successful in finding most of those facts which were relevant to an evaluation of the work for science."

My own conclusion is that President WOODWARD faced a perplexing situation, was not certain what course to pursue. There were some good things that were worth reporting (and may yet be reported), but they were not of world-shaking importance and, in view of the vicious attacks that had been made on him by BURBANK followers, he was in no mood to throw even a crumb of acknowledgement their way. And there also were the BURBANK critics, who hoped to see him authoritatively denounced. This WOODWARD could not do. It would be undignified — an admission of laxity in judgment — and besides, he harbored no such feelings toward BURBANK. His dignity permitting, he no doubt could have, with relish, issued a broadside against the BURBANK boosters. Conditions being what they were, he did nothing for either faction.

SHULL was in a predicament. He could not make a favorable report such as BURBANK and his followers expected, and his regard for BURBANK would not permit him to say derogatory things about the man and his work. He was in a position to recognize BURBANK's sterling virtues — together with his faults, which were more ridiculous than vital. These were personal matters which are reminiscent of the attitude of Santa Rosans who loved BURBANK despite his imperfections. But SHULL was under the responsibility of sitting in judgment on BURBANK's contributions to science. He has said that some things were good, and worthy of publication, but presumably there were not enough of these to offset those things that were not so good. Anything published would have to be good indeed to withstand hypercritical reviews that were sure to be made by institutional scientists. With no publication there would be nothing specific to defend. With the passage of time the need of publication seemed to diminish, and by the time BURBANK had completed his life work SHULL had become absorbed in his own genetical researches which, to him, seemed more important than working over his old BURBANK records, to recover a few flakes of gold from a large mass of sand. This brings the story down to date.

There was plenty of criticism from BURBANK's followers when the subsidy was abruptly terminated, apparently without advance

notice of any kind. BURBANK's pride was hurt. It was a blow to his prestige, and doubtless he was seriously discommoded at the sudden and unexpected loss of such an important part of his income. There was a curt interchange of letters between him and President WOODWARD. As usual his friends took up the battle and barraged the Institution with indignant and acrimonious protest. One magazine summed up the controversy in a highly sarcastic article entitled "The Application of Knowledge,"[120] presumably written by EDWARD F. BIGELOW, Managing Editor:

"Twelve million dollars could not have been invested to put into practice a grander idea than that expressed in the articles of incorporation of the Carnegie Institution of Washington — 'That the objects of the corporation shall be to encourage in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind.'

"But the value depends upon the way in which this expression is construed. Does the final clause, 'the application of knowledge', follow as the climax of all that has gone before — the end devoutly to be desired: or is it to be regarded as the least important part of the statement? The last-mentioned construction of the relative importance of the things to be 'encouraged' appears to be the one adopted, or possibly is the one that has always been maintained. This seems to be the case, since the Institution has summarily, and apparently, if not intentionally, insulted LUTHER BURBANK by discontinuing the allowance formerly given to him. President WOODWARD is strenuous in declaring that the allowance was not pledged for ten years, nor for any other special time, as Mr. BURBANK so understood it, being justified in thus believing, because one of the Trustees told him so. A Trustee is supposed to be well informed, and to speak with authority.

"It looks as if the Carnegie Institution thought it was buying a giltedged deluxe edition of 'BURBANK'; that it read and re-read him and copied him for a few years, gladly PAYING for these great privileges the paltry sum of ten thousand dollars a year. In the first years of this allowance, when Mr. BURBANK was so extensively exploited by the newspapers, when it was impossible for him to personally meet more than a small percentage of the visitors who made pilgrimages from all the world to Santa Rosa, he could easily have made twice ten thousand dollars if he had 'gone on the road' as a lecturer, and had devoted to lecturing one-half the time that he gave to the supplying of the Carnegie Institution with information. It was seemingly not in any sense an encouragement, but a shrewd bargain to use the man to the extent of its desires, in exchange for money, an exchange of which he was not aware. In other words, he, like any other interesting book, was to be read so long as he pleased the high and mighty Institution, and was then to be tossed aside with no thought of the effect on the book. So they read on, and by and by they found several blotted pages

[120] The guide to nature. September 1910.

devilishly inserted by jealousy, and they threw the book away. . . . The action brought glee to less efficient horticulturists. They rubbed their hands and patted one another on the back and said, 'We did it by our letters and resolutions.'

"From extensive correspondence with Mr. BURBANK and President WOODWARD, I quote this tender appeal and the iron hearted reply.

"From LUTHER BURBANK (letter of June the 28th): 'I would ask you plainly why do the Carnegie People refuse to give the full facts, I DEMAND them . . . I have never desired any publicity, and would always have greatly preferred private life except that it was necessary to mention my new creations in order to sell them to keep the work going; but I now desire publicity and lots of it, the more the better. I wish this thing dug to the very earth and the guilty parties exhibited to the light.'

"From President WOODWARD of the Carnegie Institution (extended letter of August the 4th, following several others): 'I have already declined to state the reasons for the action of our Board of Trustees in reference to Mr. BURBANK. Out of consideration for him especially (Oh, mark well the kind 'consideration') the history of our attempt to cooperate with him in his work should not be given to the public until after his deth' (amended Carnegie spelling and not a typographical error.)

"And then in the same letter gratuitously to the writer: 'You show plainly that having acquainted yourself with only one side of a question you are nevertheless certain that there is no other.' (This following repeated inquiries for information) 'If your mind is already made up I shall not be disposed to pursue the subject further. . . .'

"And again in the same letter: 'Similarly your sense of humor and mental arithmetic ought to show you that if we distributed our income pro rate among applicants for it they would receive less than ten dollars apiece. What would you do under such circumstances if you were a Trustee and if you knew you would be held responsible for your acts? What would you do if you had to listen to a hundred times as much advice as you could possibly use on every project the minds of men can conceive? How would you get on with your own affairs if you had ten times as many applicants for aid, positions, and shares in your income as it could stand? Would not your sense of humor come to your rescue? . . .'

"Now that you have requested my advice, I gladly give it. Go on with what you started to do, at least so far as not to bring sorrow, insult and injustice to Mr. BURBANK."

Scarcely an antifebrile statement, and I hesitate to use it even after omitting more than half of the original, along with the more intemperate invectives. I do so because time — the efficient healer — has now so far allayed the fever of controversy, with little likelihood of its ever becoming epidemic again, that it becomes possible to round out the picture of a truly remarkable man and show what a tremendous hold he had upon the imagination and confidence of

his followers. The Biblical parallel was very close. The Messiah had come, had fulfilled an earthly mission, was being crucified by unbelievers — His followers gladly took up the cross and carried on. The jeremiad quoted was not exceptional; it was typical of protests that continued to appear in the press as long as BURBANK lived, directed not at the Carnegie Institution alone, but against what was thought to be the persecutions of the scientific world in general.

BURBANK's valedictory to his foray into science appeared in one of his catalogs:[121] "Yes, after having been under 'capture' for the avowed purpose of 'the benefit of science' for five years by the Carnegie Institute of Washington, five years of care, leanness, hampering restrictions and unprofitable conditions, and having dictated to and corrected for their botanist several thousand pages, it is a most gracious relief to return to a life free from the red tape of institutional restrictions, with its accompaniment of envy and jealousy, to a life of active freedom. . . ." BURBANK, no less than the Carnegie Institution, was truly a victim of the unrestricted — almost fanatical — activities of his admirers.

[121] A new prune—the Standard. A new early cherry—the Burbank. A good little hardy plum—the Glow. A new strawberry—the Patagonia. p. 26, January, 1911.

## XVI

## BURBANK'S ADMIRERS

A PERUSAL of BURBANK's monumental scrapbook, kept over a period of 50 years and consisting of approximately 5,000 pages, gives a vivid picture of his personal and professional popularity. This word picture is a running record of what his admirers had to say about him in print. The items were taken from newspapers, agricultural and horticultural journals, magazines and advertising literature. Not all of it was laudatory but ninety-five per cent of it was. Apparently he did not always subscribe to a clipping service, for there were periods when the comments were too uniformly favorable to be truly representative of public opinion. At other times there were scattering brickbats among the bouquets. It must have required courage to preserve some of the more vitriolic comments. Scores, if not hundreds of longer articles, both favorable and unfavorable, must have been omitted to save space, as I have seen them elsewhere.

Clippings from home-town and neighboring newspapers, in the aggregate, account for many pages in the books. These tell of the arrival of visitors and the local doings of BURBANK and his business affairs. There seems to have been a friendly conspiracy to relate nothing that was disagreeable, or that in any way, even remotely, reflected on the man they loved. And the same is true today as regards his memory.

During the hectic days of 1912 to 1915, inclusive, the newspapers told of the grandiose plans of the Luther Burbank Company and the Luther Burbank Press but had little to say about how they turned out. Local papers accepted full-page advertisements of bond-selling schemes but editorially and in the news columns there was not a single comment. And when the schemes came to grief there was little said beyond what was a matter of court record. I have not found even a bare announcement of his divorce in 1896 in any of the papers, a most remarkable tribute of loyalty to a popular idol. Even more significant is the fact that all this was not brought about by plan or design, but by common consent. Editors did not need to be told; their duty was obvious and they did it.

While BURBANK's admirers were legion, most of them never saw him, for he traveled little. For more than 30 years he was a famous man — a notable — and during that time thousands visited his gardens in Santa Rosa. Admiration was not the primary urge that prompted them to go, but curiosity. However, all, or practically all, went away as admirers.

The popular press was the chief force — the mighty agency — that won both fame and admiration for BURBANK. A man may be famous but not admired. BURBANK was both, in full measure, if we reckon by numbers. Space writers whose business it was to please the reader wrote reams about BURBANK, sometimes from personal knowledge and sometimes at second hand. Editors, whose duty it was to comment on people and things in a big way,— impersonally, of course — rhapsodized about him.

So strong was the current in this direction that anyone with a contrary opinion had great difficulty in obtaining a hearing. I have before me a manuscript of book length, entitled "The Life and Work of LUTHER BURBANK", written by a geneticist — a man well qualified to discuss plant breeders and plant breeding — but publishers declined to bring it out on the ground that it was critical of BURBANK. So it was and so it was intended to be. The author tried to be fair and honest in his criticisms as he would in reviewing the work of a colleague, but he made the mistake — unconsciously, no doubt — of instilling into his otherwise impeccable statements slight traces of institutional venom. One publisher, with a fine eye to business, offered to hold the manuscript and use it *after* BURBANK's death. The author naturally refused this proposal as it would have defeated his purpose in writing the paper, which was to dethrone a popular idol.

At that, the manuscript was not as critical as was an article published in a trade paper about this time, which was of the debunking type, but the public heard little of it as the periodical circulated chiefly among florists and gardeners. This clientele was much impressed and pleased at the exposé as many of them were in the business of selling seeds and plants — also in improving them by breeding — and therefore were professional rivals of BURBANK.

BURBANK's admirers employed two successful means of approach in building up and maintaining the prestige of the man: by playing up his lovable character and by depicting him as a wonder-worker with plants. Emphasis, of course, was on the latter attribute; and, according to the viewpoint, temperament or personal bias of the writer, he was variously credited on the one hand with being a scientist of high order and on the other with being in league with the supernatural. Of course they could not say, in so many words, that he possessed supernatural powers, but, whether intentional or not, that certainly was the impression left in the minds of many of their readers.

Admirers of BURBANK rarely conceded the possibility that some of his productions might not prove to be a success. That they would be a success, that is, useful, was taken for granted and the natural corollary was that he was, therefore, a benefactor of mankind. And the stories were made intriguing by enveloping his performances in an aura of mystery. To the popular reader this made the greatest appeal of all. BURBANK himself did not relate any such stories; they were invented by his enthusiastic admirers. However, by constantly stressing the long hours of unremitting

labor which he devoted to his plants in effecting their improvement — for the most part absolutely true statements — they cleared the way, as it were, and prepared the minds of the credulous for accepting the fantastic tales that appeared in the press, often in the guise of popular science. Owing to the almost universal lack of information about the prosaic facts of plant propagation (budding and grafting in particular), as well as of pollination and seed formation, even otherwise well-informed persons are apt to display a child-like curiosity and admiration toward the person who propagates plants and cross-pollinates flowers, and attribute to them powers they are not entitled to. The processes seem mysterious, so they are willing to believe mystery stories about them. Skillful writers, with little or no technical knowledge of plant improvement, saw their opportunity and availed themselves of it by writing catchy stories of the wonders performed by BURBANK. Some wrote BURBANK panegyrics for the love of it or because they were enthusiastic admirers of the man, but the worst offenders were those who did it for pay and with a cynical disregard of facts.

I say little about one class of BURBANK admirers — those who sold his productions. After paying a few hundred or a few thousand dollars for a new flower or fruit with full power to multiply it and sell it at retail, it would have been a strange merchant indeed who did not eulogize BURBANK and cry his wares from the housetops. Some no doubt purchased for the advertising value of the BURBANK name regardless of whether they admired the man or whether they thought the product was intrinsically valuable, but mostly the purchasers were followers of BURBANK and believed in the things he produced. However, being a customer was sufficient incentive for glorifying the man and his accomplishments and to this class of boosters he was indebted for much of his favorable publicity.

The clergy made valuable contribution to his fame by way of the sentimental route. And there was not an iota of deception here, for they believed everything they said. In depicting his idyllic life among his flowers, his stainless character and his love of children, they were on safe ground but when, in their enthusiasm, they attributed his succcess to Divine guidance, a distinctly wrong impression was created. The credulous who believed such stories were certainly left in a state of mind to be imposed upon by those who exploited BURBANK for personal gain. And why not believe them when the persons making the statements were men of undoubted integrity?

Many years ago I was traveling in the back country of the Missouri Ozarks. At a village 30 miles from a railroad, where I stopped for the night, excitement was in the air caused by the reported discovery of a fabulously rich copper deposit in Arizona. A promoter had sold stock right and left by the clever device of telling people on his first visit that he did not ask them to accept his word but that he would pay all the expenses of anyone they might select to go to Arizona and see for himself what he had to

offer. The man the community had the most faith in was the minister of a local church who made the trip and reported that with his own eyes he had seen a whole mountain of copper which only awaited development. This turned the trick and the promoter made a cleanup and moved on. And this had just happened when I arrived. The populace was in a happy state of mind with rosy anticipations and could talk of nothing else but its good fortune. I was a doubter in the midst of universal optimism and got in bad — very bad — by asking what their good minister knew about minerals, and copper ores in particular. I was so unpopular that I had to hasten my departure. Yes, you have guessed the outcome. The minister was duped and the whole thing was an unscrupulous fraud.

Honesty and good intentions are excellent qualities in a man but they do not make him a horticultural or mineralogical authority. However, where men of known honesty and established character — as the clergy — spoke highly of BURBANK and praised his accomplishments, they enhanced his reputation. In the end, though, the clergy as a class repudiated him because they did not like certain theological views he was alleged to have expressed but his fame was so great that it safely withstood this stress.

The public understood that the ministry had endorsed BURBANK as a sort of miracle man as a plant breeder, and this opinion coming from such a highly respected source was widely accepted. When the clergy later denounced him for his religious views — but not as a wonder-worker — his admirers refused to drop him. True, many religious people were saddened but their devotion to their idol continued undiminished. A common defense was, "I don't believe he said the dreadful things attributed to him, but even if he did, his religious views are his own private affair and we have no right to criticise them." [333]

Perhaps the most consistently faithful admirers of BURBANK are to be found in our public schools. To be sure they did not help much, if any, toward establishing his reputation in the first place but they certainly seized upon it when it was established and carried it forward by classing the new favorite along with WASHINGTON and LINCOLN. Ten and twelve-year-old children throughout the land are taught that WASHINGTON delivered us from our oppressors and moulded the jealous colonies into a powerful nation with a constitution that guarantees all the things that a democracy holds dear; that LINCOLN was the Messiah that arose in the dark hours of our need to rescue the Union from disruption; and that BURBANK by his creative genius gave the world both beauty and sustenance — things of loveliness to please the eye and exalt the soul, and things of worth to feed the mouth and fill the purse. In short he is represented as one of the greatest peace-time heroes our country has produced.

[333] The gist of scores of letters to the author from religious persons in all walks of life, including the ministry.

All of which stirs the imagination of the child and he never forgets the BURBANK character that has been pictured to him; and certainly no harm has been done unless the teacher becomes too enthusiastic and overdraws the picture by representing the character either as a great fundamental scientist or as being in league with the supernatural. In both directions lies trouble for the pupil when he grows up and repeats these views only to be ridiculed. If he becomes a student of science in later years some of his youthful ideals will be shattered when he discovers certain facts for himself. It cannot be repeated too often that BURBANK really did perform a notable service to science, and history will not permit his name to be forgotten, but his admirers must not claim too much for him.

BURBANK's fame will be perpetuated through the schools because his life is a most attractive subject for children to study. And, if his accomplishments are fairly presented, and no liberties taken with the facts, his legitimate fame will remain unsullied. If romanticism and mysticism predominate in the presentations there may be a reaction that will tend to discredit the man entirely which would be very unfortunate.

## XVII

## BURBANK'S DETRACTORS

THOSE who spoke disparagingly of BURBANK's work fall into four general categories: Persons connected with scientific institutions — state, federal, and private; jealous business rivals and competitors; dissatisfied purchasers of his products; and crusading debunkers. Truth is the guiding star of all scientists worthy of the name and as a class they are prone to be severe — even ruthless — in their criticism of persons who make statements not properly supported by acceptable evidence. Some may go further and question a man's fitness for laying claim to scientific achievement by scrutinizing his formal education — what degrees he holds and whether he was trained in this or that laboratory, of this or that institution — and if he does not measure well by conventional standards, his claims may be dismissed as being unworthy of serious consideration. This would be particularly true of those scientists who labor for the inner glory of making contributions to the advancement of abstract knowledge. These would condemn BURBANK unequivocally, if they took the trouble to think of him at all.

Scientists in technical institutions like the agricultural colleges, state experiment stations, and the United States Department of Agriculture, while faithful to the ideals of their cult, are nevertheless realists, and therefore less disposed to look with jaundiced eyes upon the offerings of anyone, be he layman or to the manner born, if his contribution can be shown to be useful to society. But agricultural scientists have another duty aside from teaching and research — they are expected to give technical advice on everything from animals to zinnias, and to serve as watchdogs for the protection of the public from frauds that may be perpetrated under the guise of agricultural betterment. And they take this last obligation seriously. Thousands upon thousands of inquiries, in the aggregate, are answered annually. Many of these are concerned with the value and trustworthiness of new varieties of plants offered for sale. It is the duty of the public agencies mentioned to keep posted on such matters.

When some unusual crop plant comes on the market there is certain to be a flood of inquiries about it. This was what happened when the so-called thornless cactus was first widely advertised. As a matter of safe policy, institutional workers are cautious about recommending the planting of new things, particularly for income purposes, even when promising, and the customary advice is to wait until the novelty or new thing has been subjected to experimental test. This was especially true in the case of the cactus, for it was

not only a new crop but an unusual one and, moreover, extraordinary claims were made regarding its value.

BURBANK made some pretty tall claims himself but promoters went much farther. BURBANK declared they were discrediting him by saying that this semi-tropical plant could be grown far north whereas he insisted that it could withstand only a few degrees of freezing. The United States Department of Agriculture officials took the more fundamental stand that forage cactus of any kind — spiny or spineless — was at best only an emergency crop to be used in years of extreme drought when both range grass and water were scarce. They readily conceded that cactus could be grown in regions of low rainfall — that it is adapted to the so-called deserts of the Southwest — but made it clear that growth would be slow and that no such yields as claimed for it could be expected without cultivation and irrigation.

The inference to be drawn was that under these circumstances some forage crop with higher nutritive value should be grown instead of cactus. It was further pointed out that, while the spiny Opuntias have as high feeding value as the spineless forms, it is necessary to go to the trouble and expense of ridding the slabs of their spines by singeing them off with a blow torch. On the other hand experience had shown that cactus without spines had to be fenced to protect it from rabbits as well as cattle and sheep — to prevent them from exterminating it — thus making it a farm rather than a range crop.

Substantially the same conclusions were reached by Professor J. J. THORNBER, Director of the Arizona Agricultural Experiment Station, after experiments in growing and feeding both spiny and spineless cactus. The fanciful stories written about the possibilities of spineless cactus authored by irresponsible space-writers and others along about 1903 to 1912 caused an avalanche of inquiries to be sent to the United States Department of Agriculture in Washington and to many of the State experiment stations, and in accordance with their policy of conservatism, the replies were uniformly unfavorable. BURBANK's friends and admirers quickly leaped to his defense although in many instances they were defending the statements of dealers in cactus and the emanations of careless writers rather than what BURBANK claimed. This brought sharp retorts from the institutional guardians of the public. Because BURBANK had made extravagant claims in the first place and continued to repeat them, and because everything that others said in praise of the crop was understood by the undiscriminating public as also coming from BURBANK, the discussions narrowed to a controversy between BURBANK and the cactus specialist in the Department of Agriculture, Dr. DAVID GRIFFITHS, with much bitterness on both sides.

On the whole, institutional critics were not motivated by personal animus when they encouraged people to resist the sales talks of those who had BURBANK products to sell; it was all in the day's work in the performance of their duty as protectors of the

body politic. However, the persistence with which dealers — presumably with BURBANK's blessing — continued to push the sale of cactus in the face of governmental opposition convinced many officials that BURBANK had violated the primary principle of a scientist in that he was not amenable to the truth. And this view has been handed down to the present generation and has given him the reputation of being a tricky salesman. Also it was intimated, and even directly charged, that there was no such thing as a completely spineless cactus and that the forms he was selling were "spineless" by nature and that he had received them from his collectors in some other country and proceeded to propagate and sell them as his own creations. Some good men have believed this but I have the evidence of Dr. SHULL, Professor DE VRIES, and of two or three persons who worked for BURBANK — as well as several photographs of seedling collections of cactus taken from 1901 to 1905 — which I think sustains his claim that he did produce certain forms of "spineless" cactus by a process of hybridizing, selecting and hybridizing again and again over a period of eight to twelve years. BURBANK did not claim to have produced an *absolutely* spineless form but had succeeded in reducing the spines to a point where the plants could be used as a roughage by animals without danger. He also admitted that forms as near spineless as his were to be found in nature — in fact he had received such specimens from the collections of Dr. GRIFFITHS in Washington, D. C., and Chico, California. My studies convince me that he has been charged with some things that he is not guilty of.

Granting that he was a shrewd salesman and that he refused to admit that cactus was not a valuable forage plant, I cannot see —

TEXTFIGURE 5.—COVER OF A 1912 LEAFLET.—Nearly twenty years after BURBANK's death, he is still criticised because he advocated the planting of cactus for fruit and forage, and for claiming to have originated varieties devoid of spines. Here are the facts: From Mexico, the Mediterranean countries, and other places he brought together a large collection of cactus types of the genus *Opuntia*, chiefly *O. Ficus-indica* and *O. Tuna*. Some were exceedingly spiny, others almost spineless. A large-scale breeding program was started in the belief that fruiting types could be much improved, and other types made suitable for forage by getting rid of the spines.

BURBANK never claimed that his was the only "spineless" cactus in existence but did claim, with justification, that by breeding he himself had produced varieties "as smooth as a watermelon." He admitted that DAVID FAIRCHILD of the United States Department of Agriculture sent him a specimen collected by one of their explorers, that for all practical purposes was spineless and that others might be found in nature.

BURBANK believed in the value of cactus, particularly for forage, and made enthusiastic claims for it, but it was the doings of others who purchased it for resale, that brought the industry into disrepute. Salesmen and irresponsible writers made ridiculous statements that went the rounds and the public attributed them to BURBANK.

Stockmen are on record as having testified that cactus was a valuable emergency feed for range cattle, but impractical to grow for that purpose, as it had to be fenced lest the animals eat it into the ground. Dairymen made affidavits, too, that it was a good supplemental feed for milk cows, but again it must have been unworthy in some way, as it was little used.

## The Gold Medal Newest

# Agricultural-Horticultural Opuntias

# SPINELESS CACTUS

"How to Judge Novelties, Look to Their Source," and, also, if Possible, Purchase Direct from the Originator

MANY new trees, plants and seeds are grossly misrepresented by a few dealers who trade on the reputation of reliable firms, often doing a thriving business by selling trees and plants in localities where they very well know that they cannot thrive; this and the substitution of inferior or wholly worthless trees or plants under the name and reputation of good ones has been, and is now being carried on persistently and systematically by several parties who victimize those who deal with them by trading on the reputations of reliable firms and good trees.

An especially cruel form of this is the persistent pushing of the Spineless Cactus, Crimson Winter Rhubarb and other tender plants for cold climates which cannot live where the ground freezes an inch in depth.

It should be the duty and privilege of every good citizen to aid in exposing and routing all who are obtaining money under these false pretenses.

Having been in business almost forty years, millions of trees and plants raised in my establishment are now bearing fruit, not only in the Western United States, but everywhere on earth where the sun shines and trees can be grown. Does this forty years record of just dealing mean anything, and is it surprising that such a reputation should be worth trading on? **Counterfeit coins are not counterfeited—it is the genuine ones that are misrepresented.**


## Luther Burbank

SANTA ROSA, SONOMA CO., CAL., U. S. A.


May 1, 1912.

since he believed in it (at least in the earlier years when the original controversy was raging) — that all of this had anything to do with his being a scientist. It was no evidence, either for or against him. I have in mind, at the moment, an institutional man with an international reputation as a keen and productive scientist who is so avid for money that he recently patented a hormone that had been discovered in his laboratory and tried to bludgeon manufacturers into purchasing it, when he knew another patent was pending on a type of hormone superior to his; and when he failed to make the sale tried, by shady methods, to discredit the work of the rival group of research workers. When this becomes known, as it will, it may injure his reputation as a man but it will still have to be admitted that he is an able scientist.

The moral, of course, is that one must be a good scientist — must have conformed to the traditions and been accepted by his contemporaries—before he can afford to risk tarnishing his reputation by commercializing his talents. But institutional scientists, as a rule, do not have to worry unduly about where the money is coming from to support their laboratories and pay their salaries. BURBANK had to make his discoveries pay all the expenses of his home, gardens and greenhouse and if there was anything left he might call it a salary.

Another echo of the spineless cactus episode was the withdrawal in 1909 of a subsidy which the Carnegie Institution of Washington had made to BURBANK five years previously. The cactus controversy had exhibited BURBANK before the scientific world in the worst possible light and thus became a culminating incident in deciding the Institution to discontinue supporting his work.

At about this time a crusading debunker played an important role in an effort to discredit BURBANK. H. W. COLLINGWOOD, Editor of the *Rural New Yorker,* an influential agricultural journal, conceived the idea of what is now known as "honesty in advertising." A berry plant called the Wonderberry, originally sent out by BURBANK under the name of Sunberry, was being extensively advertised by JOHN LEWIS CHILDS, who had purchased the rights to its distribution. Mr. COLLINGWOOD undertook to prove that the Wonderberry was not only worthless as a fruit but probably poisonous as well. As usual, BURBANK was held by the public to be responsible for all the exaggerated statements made by the CHILDS Company. He did praise the novelty when it was first produced, which caused Mr. COLLINGWOOD to take him to task and to speak disparagingly of his work in general.

In 1909 BURBANK's reputation among institutional scientists was at a low ebb. What editors of rural publications, other than the *Rural New Yorker,* thought of him is not clear. Few had the courage to speak out as COLLINGWOOD did. With the rank and file BURBANK was still extremely popular despite the cactus and Wonderberry incidents. Apparently the average citizen thought these were not the only times the "city slickers" had attempted to

sell things of little value to the public. In the cases of both the cactus and Wonderberry many, if dissatisfied, undoubtedly placed the blame where it chiefly belonged — on the distributor.

Here and there jealous competitors of BURBANK carried on an under-cover warfare of calumny against him but these efforts at undermining his character and business integrity met with little success. I personally knew one nurseryman — a man himself of the highest integrity — whose outlook was so warped by jealousy or envy that he could not give BURBANK credit for a single worthwhile accomplishment. Incidentally, this man was also a breeder of certain fruits and was much chagrined that his hybrids which he thought were improvements over existing varieties of their kind received but little attention. He could not see why so much honor was accorded BURBANK and so little to himself. On the whole there must have been hundreds of others, especially in the floral trade, who were similarly situated, who sniped at BURBANK. Their plaints are to be found in many of the trade papers of the day.

Altogether, over the years, disappointed purchasers of BURBANK products account for a sizeable volume of criticism of the man. The largest part of this adverse criticism was engendered during the three or four years the so-called Luther Burbank Company of San Francisco was in business. Numerous cases have come to my attention where persons thought they had been dealing directly with BURBANK when as a matter of fact he knew nothing about the transactions. On the other hand BURBANK himself undoubtedly incurred a certain amount of hostility by reason of dissatisfied customers to whom he had sold flowers or fruits. Novelties have a way of not making good. Happily for him, most purchasers of new and highly touted things buy with their fingers crossed, so to speak, and do not expect too much.

The detractors of BURBANK were many and diverse but the volume of approval from his friends and admirers had a way of drowning out the voices of those who disapproved. Faulty or perfect, guilty or innocent, the *hoi polloi* loved him during his lifetime and cherished his memory after he was gone.

## XVIII

## BURBANK'S PLACE IN THE HALL OF FAME

THROUGH living forces which cannot be stemmed, fond memories of LUTHER BURBANK will continue to be enshrined in the hearts of a people who choose their own heroes and worship as they please. In some respects he was one of the most remarkable men of his time. For a third of a century he swayed the sympathies of a multitude of people, high and low, and this he did without being an orator, warrior, or forceful writer. Of course, the popular press was the influence that made people love him and revere his memory. But this kind of fame is usually fleeting. Since the fame of a popular hero is ordinarily built upon sentiment, a single misstep may topple him from his pedestal. Despite many missteps, BURBANK's fame has not departed, even long after his death. And his memory has not been perpetuated by erecting monuments or by other visual reminders of his life, although these are now beginning to be in evidence. There are a few parks and public schools named after him and one state — California — observes Arbor Day on the date of his birth. All these are mostly local tributes. A recent recognition of a national character was the issuance of a commemorative postage stamp in 1940. The town of BURBANK in southern California was not named after him as some have supposed.

It may be argued that the tributes mentioned were the work of small groups of zealots, that there has been no spontaneous demand on a large scale for any sort of monument to his memory, and I can only reply that neither has there been any widespread protest against the honors paid to the man, except in the case of the stamp and that was only a brief flurry mostly confined to institutional circles — bewilderment that BURBANK had been classified as a *botanist* and then singled out for exceptional honors when there were other *botanists* who were obviously more worthy. Isolated individuals also objected to having JANE ADDAMS classified as a *scientist,* a protest that had merit, not that she was unworthy of being honored by a commemorative stamp.

BURBANK's popularity was not due to any particular classification or designation that might be applied to him. The great mass of people do not think of him as a botanist, geneticist, plant-breeder, or hybridist; horticulturist, gardener, or naturalist; but as a person who struck out alone into the wilderness of Nature and with his own hands so manipulated plant life — just how they don't know or greatly care — as to produce or "create" a multitude of new forms, some of them useful, others merely beautiful, and that

altogether he led a busy, productive, exciting life and by his unselfish labors made the world a better place in which to live. The average person does not know that he gave us a whole galaxy of new plums, a famous rose, a daisy that spans two hemispheres, berries to please the taste and lilies to charm the eye, he merely knows — or believes — that he did marvelous things, was a man of blameless character and eminently worthy of his confidence and admiration. And love and faith combined constitute a power equal to the famous lever of ARCHIMEDES.

Geneticists, a small but influential group of research men in our colleges and higher institutions, have always felt that BURBANK was a stultifier of their science and that his bid for fame as a plant-breeder was both impudent and absurd. Judged by their standards he would not rate very high, but a host of people — many of them identified with scientific pursuits — have other criteria for judging his worth to society and arrive at very different conclusions. It is readily conceded that he contributed little to the principles of breeding but much to its possibilities. He was well established in his career of practical breeding — hybridizing for the improvement of cultivated varieties — before genetics, the science of breeding, was born. It was this pioneering spirit that endeared him to thoughtful people.

Daring to announce to the world that plant improvement with him was a profession rather than a hobby made him a romantic character. Stories of his prowess were carried around the world by travelers and the popular press. His name became a by-word for plant improvement, and his practical successes undoubtedly stirred the imagination of both amateurs and students of breeding. Scientists were stimulated to make eager search into the laws of heredity. The public began to understand what was meant by plant-breeding and showed a willingness to support the new science in their institutions.

The science of breeding grew and advanced rapidly during the first two decades of the new century, and though it may not be generally recognized, the movement is traceable to BURBANK as a potent activator. Professor H. J. WEBBER, a pioneer plant-breeder and geneticist and a contemporary of BURBANK, has declared that [128] through the influence of BURBANK the science of plant-breeding was advanced by at least twenty years and for this accomplishment alone, he deserved a sizeable monument to his memory. WEBBER was in the Government service from 1892 to 1907, a period that encompassed the rediscovery of MENDEL's laws of heredity and the release by BURBANK of his original list of "New Creations." For seven or eight years he was in charge of the plant-breeding laboratories of the United States Department of Agriculture and was, therefore, in a position to lend a guiding hand in the development of the infant science of genetics in this country as well as to contribute knowledge of the subject through

[128] By conversation and in a letter to the author, dated May 14, 1934.

his own researches. Having known the history of genetics for forty years, even been a part of it, I value his judgment when he looks down the vista of four decades and says that BURBANK, by his labors, vitalized and hastened the growth of a line of endeavor that might otherwise have lagged on account of a lack of popular interest.

To the popular mind BURBANK was a fetish — an object of unreasoning devotion. In the last analysis his fame was based on intangibles. I have asked hundreds of persons why they thought he was a great man. Comparatively few could give any definite reasons although their convictions were strong. Upon analysis, fame is seen to be a bewildering attribute — sometimes funny or even ridiculous. It may have close kinship with notoriety and an unthinking public may mistake the one for the other.

If fame comes as a result of "common talk" or "opinion generally diffused" as the dictionary says, then history will accord LUTHER BURBANK a place in our list of notables. Few men of his time, in private life at least, were more sought after or more talked about. To the public he was a romantic figure and his admirers referred to him in the most extravagant terms. His name was known to the reading public in foreign lands and at the height of his career even to the illiterate. But by the same criterion JESSE JAMES the bandit might also have qualified for a place in the hall of fame. Make no mistake about this, bizarre as it may sound, for I lived in the Middle West and was a good-sized youngster when JESSE was bumped off, murdered, they said, by a "paid assassin" or "stool pigeon." There was a great upsurge of emotion at the manner of his riddance, forgetting that all other methods had failed, and even quite nice people were wont to say that JESSE never molested the common people, that he robbed only the plutocratic railroads and banks, and "sich." The newspapers of the time condemned the peace officers, played up JESSE as an American variety of Robin Hood — not always in these words, to be sure, but carefully and deliberately leaving that impression. They made of him a popular hero, for the public must have a shrine at which to worship.

I am not trying to, and have no thought of, comparing BURBANK with JAMES. Far from it. I am merely trying to show what a funny thing fame is. Another funny thing about fame — or notoriety — is the extent to which the famous one straightway becomes an authority in fields wholly unrelated to his specialty. More correctly speaking it is the thoughtless public that pursues the notable and solicits his opinions on all manner of questions of current interest. The press is an avid promoter of this kind of cheap hero worship. In fairness it should be stated that in the beginning it is usually some enterprising newspaper reporter who seizes the opportunity to publicize the doings of an individual simply because he needs a story of some kind for his paper and not because he cares a hang about the actual achievements of his hero of that day. BURBANK was willing to discuss metaphysics and

theology, and HENRY FORD had a sure-fire recipe for world peace. On the other hand General GRANT and MARK TWAIN knew how to reply to inquiries outside of their knowledge and designed to make them ridiculous. One was forceful and profane; the other could neatly turn the tables on his tormentor and make *him* ridiculous.

The public is willing to overlook much in its heroes if their fame has a sound basis. Eccentricities, egotism, and even moral lapses are tolerated. The public cannot love a hero who is a rake in private life but can admire even a Byronesque character if he has real accomplishment to his credit. BURBANK was both loved and admired.

Out of the muck of charges and counter-charges pertaining to BURBANK's achievements, the following facts may be recorded in his favor: that he produced or introduced (1) a variety of potato that was in great favor all over the United States for thirty or forty years, and after a lapse of seventy years is still planted; (2) a dozen plums and prunes that have survived the test of half a century and continue to be popular for both market and home use in many parts of the world — particularly in California and South Africa where several of them are leaders for shipping purposes; (3) several kinds of vegetables that were more or less planted for ten to twenty years; and annual and perennial flowers, some of which enjoyed favor much longer than is the average life for such things. His most notable accomplishments in the development of useful varieties of flowers were with lilies, cannas, roses, amaryllids, dahlias, daisies, gladioli, Richardias, Hemerocallis, Watsonias, poppies, Tigridias, and verbenas.

BURBANK introduced over 250 varieties of fruits alone. These consisted of 10 varieties of apples, 16 blackberries, 13 raspberries, 10 strawberries, 35 fruiting cacti, 10 cherries, 2 figs, 4 grapes, 5 nectarines, 8 peaches, 4 pears, 11 plumcots, 11 quinces, 1 almond, 6 chestnuts, 3 walnuts, and 113 plums and prunes. While he collected cacti that were practically spineless — DAVID FAIRCHILD, the explorer, sent him one — he definitely did breed a type of his own that was free of spines and bore only a few more or less harmless spicules.

Of all his fruits, the plums were his greatest contribution. Twenty varieties of his plums — eighteen per cent of his total output — are still widely planted throughout the United States and other countries. Ten of the number are standard shipping varieties wherever Japanese plums can be grown, as in California, South Africa, Argentina, and Australia. In California alone they form the basis of a huge industry. At present there is a total of about 24,000 acres of BURBANK's plums, which means upwards of 2,000,000 trees. Thousands of carloads are shipped annually and the returns run into the millions.

The exact number of new strains and varieties of plants introduced by BURBANK during a span of fifty years is not known and is difficult to determine at this late date when so many of them have disappeared. However, the number is over eight hundred.

Florists and gardeners regard ten years as the approximate average life of new varieties of flowering plants that appear upon the market, when they are superseded by something better in some respect or because there is a change in the public taste. And a variety must possess real merit to endure that long. Many do not and BURBANK's productions were no exception. On the other hand, some of his things are still offered for sale by dealers after forty years have gone by.

The botanist will be interested to learn that at one time or another during his lifetime BURBANK performed selection or hybridizing experiments with almost 200 plant genera. The exact number so far as can be determined with a fair degree of certainty from his published writings was 188, but probably there were others. No attempt has been made to reckon the number of species involved. Usually there were 1 to 3 species from each genus but five or six were not uncommon. *Lilium* was an extreme instance in which 20 species were employed. It must suffice to say that species from 121 genera yielded varieties and strains that were deemed worthy of introduction, while his studies on 67 genera were barren of practical results.

For these concrete accomplishments and because he was the ferment that stirred others to advance the science of breeding, an intangible achievement, to be sure, but his greatest from the viewpoint of science, he is definitely entitled to a place in the hall of fame; but, all factors duly considered, the best that I can do is to assign him a front seat among the minor prophets, a front seat because of the unusual fact that here is one prophet, at least, who was not without honor among his home people.

## XIX

## SUMMARY OF BURBANK'S PRODUCTIONS

THE persevering reader may desire more particulars than have been given regarding BURBANK's output as a plant breeder. To meet this hypothetical demand, I submit a summary of his more important productions, taken from my technical report, *Luther Burbank's Plant Contributions,* recently published by the University of California.[124]

FRUITS:—

**Apples.**—Ten varieties, mostly selected seedlings, were announced. Two of these, the **Goldridge** and **Winterstein,** were widely planted in home gardens. The high price, five dollars per tree, no doubt limited their sale. Distributed by BURBANK.

**Blackberries.**—Of 16 varieties announced, **Himalaya,** a second generation selected seedling from seeds obtained from India, "through exchange", became the most famous. **Paradox, Phenomenal** and **Primus**, blackberry-raspberry hybrids, were much discussed half a century ago, because BURBANK maintained that they should be regarded as new species. The first was an $F_4$ cross between the Crystal White blackberry and Shaffer's Colossal raspberry. A photograph of the hybrid shows that the fruit closely resembled the modern Boysenberry. The second variety was an $F_2$ selection from crossing the wild California dewberry (*Rubus vitifolius*), with the Cuthbert raspberry. The fruit resembled the Loganberry. **Primus** was an $F_1$ cross between the California dewberry, *R. vitifolius,* var. Aughinbaugh, and a Siberian raspberry, *R. crataegifolius.* In commercial cultivation for 15 or 20 years, particularly in Oregon.

The thornless blackberries, the **Santa Rosa** and **Sebastopol,** were unique but never very important. The so-called white blackberries—**Iceberg** and **Snowbank,** the first an $F_3$ hybrid between Lawton and Crystal White, and the second, one of its seedlings—were distributed throughout the United States by JOHN LEWIS CHILDS of Floral Park, New York. Widely planted by amateurs but never a commercial success.

**Blueberry.**—The blueberry was hybridized by crossing two species of *Vaccinium,* "one from West Africa and the other from the west coast of America."

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[124] The full report may be obtained, free of charge, by writing to: Publications Secretary, Agricultural Experiment Station, Berkeley 4, California, and asking for Bulletin No. 691.

**Cactus.**—For several years BURBANK maintained a large collection of cactus species, mostly belonging to the genus *Opuntia,* which he collected from various parts of the world. Mexican species predominated. This was one of his largest breeding projects. Existing photographs show vast collections of seedlings. Close-up views disclose much variation in size and shape of slabs as well as degrees of spininess. The breeding objectives were fruit and forage. Many varieties served both purposes. To be suitable for forage the spines had to be eliminated. This was accomplished to a high degree, several varieties being practically spineless and a few entirely so. This extreme condition, so far as I am aware, does not occur in nature. Marked betterment was effected in improving the fruit but the best fruiting varieties were apt to be possessed of at least some spines. Altogether 69 varieties were introduced, 35 being recommended for their fruit and 34 for forage. Cacti for forage enjoyed only a brief season of popularity, although fruiting varieties may yet be found in private gardens, but the names are usually lost. This is regrettable, as many of them possessed real merit.

**Cherries.**—Between 1900 and 1914 ten varieties of cherries were announced. One, the **Burbank,** a seedling of the Early Purple Guigne, proved to be of lasting value as an early shipping variety. Apparently BURBANK did not practice back-crossing with cherries, merely selecting what he considered to be the most promising plants from the $F_1$ seed bed and grafting them upon the branches of an old tree. When they fruited the final selections were made.

**Nectarines.**—Some attention was given to nectarines and at least 5 varieties were introduced but interest in the project seems to have been desultory.

**Peaches.**—Although eight varieties of peaches were announced and one or two were rather widely planted by amateurs, peach breeding was far from being a major interest. In view of the possibilities for peach improvement—amply demonstrated by others during the last 10 or 15 years — it is strange that BURBANK neglected this field. The only explanation I can offer is that he was not amenable to advice from persons who were familiar with market demands. In extenuation, it might be added that his energies were being directed toward things that promised more spectacular results.

**Pears.**—BURBANK did not interest himself much in the improvement of our cultivated pears. Rather, on account of his predilection for novelties, he began early in his career to import Oriental pears and use them as the basis for his breeding experiments. Late in his life he did hybridize some of the varieties of the day. Four new varieties were announced but they were not important.

**Plums and Prunes.**—Horticultural literature will perpetuate BURBANK's name for his enrichment of the fruit gardens and orchards of the world with useful varieties of plums and prunes.

His beginning was something of an accident. He imported his first Oriental plums from Japan in 1885, for the same reason that he brought in pears from China—with the hope of finding an acceptable novelty; and what bonanzas the blood plum of Satsuma and the Botan or Abundance proved to be! These two turned out to be not only excellent varieties which will continue to be planted for years to come, but they served as breeding stock, and through hybridization, their qualities were infused into numerous varieties that were the product of many related species.

While BURBANK is known best as the introducer of Japanese plums, he by no means confined his attention to that species. In all he made use of at least eleven species: *Prunus americana, P. Besseyi, P. domestica, P. insititia, P. maritima, P. Munsoniana, P. nigra, P. Pissardi, P. Simonii, P. subcordata,* and *P. triflora.* From these a total of 113 named varieties were derived, some resulting from simple crosses between varieties representing two species, others being the product of several crosses involving more or less complicated heredities. Only 37 of the more interesting varieties will be discussed here: **Abundance** was a seedling of unknown origin. One of the twelve seedling plums imported from Japan by BURBANK in 1885. Originally called Botan. Name changed in 1897. Perhaps more widely grown than any other Japanese plum, although others have a larger acreage. **Ace**, announced in 1927, is still cultivated in a small way in parts of California.

**Alhambra** was mentioned by DE VRIES[125] as being a "sevenfold combination" including the species *P. Simonii, P. Pissardi, P. domestica, P. triflora, P. americana,* and *P. nigra.* No record of its having been offered for sale, although it might have been sold without announcement, as many of his things were. **America** was a successful hybrid between *Prunus triflora* and *P. Munsoniana.* Widely planted by amateurs. **Apple**'s exact parentage is not known except that it was an $F_2$ selection from cross-bred seedlings, with Satsuma and probably Robinson in its line of ancestry. Well known in South Africa.

**Bartlett** was a cross between Simon (*Prunus Simonii*) and Delaware, a *triflora—Simonii* hybrid. Widely planted throughout the United States, but never popular as a market plum. The **Improved Beach** was probably a selected seedling of the wild *maritima*, or beach plum of the northern Atlantic Coast.

**Beauty**, a highly successful market variety—one of the most important of the Oriental plums—was "the product of a very complicated heredity including several species." A favorite shipping variety in California and South Africa. **Burbank**, a seedling imported from Japan in 1885, is grown extensively throughout the United States. A leading shipping variety in California and popular in South Africa for fifty years.

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[125] HUGO DE VRIES, A visit to LUTHER BURBANK. Pop. Sci. Mon., pp. 329-347, Aug. 1905.

**Cazique** was similar to Beauty in appearance, but inferior to that variety. Planted in home gardens. **Chalco** was a Simon-Burbank cross. BURBANK said it was produced after twelve years' work in crossing *Prunus Simonii* with varieties of *triflora* and *americana*. Extensively planted but never an important market variety. **Choice** was a seedling of America, the latter a cross between Robinson and Abundance. Important only for home planting.

**Climax** was a cross between the varieties Simon and Abundance. A highly important shipping variety for 30 years but now on the decline. Still about 1,000 acres in bearing in California. **Combination** was probably a mixture of *triflora, Munsoniana,* and *Simonii*. Extensively planted for shipping purposes for twelve to fifteen years. Now of little importance. **Conquest** was a *Prunus domestica* × *insititia* hybrid, effected by pollinating the French prune or Prune d'Agen, with the bullace or wild plum of France, known there as the *sans noyau* or seedless plum. Several generations of reciprocal crosses were required to produce the **Conquest,** which has only the rudiments of a seed. Much planted by amateurs as a plum but never dried as a prune.

**Delaware** was a cross between Satsuma and Kelsey. Home use; not known in the markets. **Duarte** resulted from a cross between America (*Prunus Munsoniana*) and Climax (*P. triflora*). A profitable shipping plum in California where 2,000 acres are still in cultivation. **Eldorado** has been grown commercially in California for thirty years. A *triflora-Simonii* hybrid. **First,** BURBANK claimed, was the product of crosses and recrosses between Wild Goose, Hawkeye, Hammer, Milton, Wyant, Wayland and Burbank varieties. Interesting but horticulturally unimportant.

**Formosa,** a mixture of *triflora* and several other races, was announced in 1907. One of the best and most successful of the Japanese type in all countries where grown. Still important as a shipper in California. **Gaviota,** *triflora* × *americana* (and probably other species), was first introduced under the name of Rice Seed. Still commercially important in California and South Africa. **Giant** was a cross between French (Prune d'Agen) and Pond (more properly Hungarian). Grown in a small way as a shipping plum. Rarely used as a prune. **Golden,** now sold under the name of Gold, came from a seed of Robinson fertilized by Abundance. Introduced by STARK Brothers of Louisiana, Missouri, in 1893. May be found in fruit gardens in many states. **Hale,** a Kelsey-Satsuma (*triflora* × *Simonii*) cross, was originally known as Prolific. J. H. HALE of South Glastonbury, Connecticut, changed the name and introduced it in 1894. Widely planted but not successful—trees not hardy and fruit too tender to ship.

**Maynard,** a *Prunus triflora* × *P. Simonii* hybrid, was introduced by the Oregon Nursery Company of Salem, Oregon, in 1903. In home gardens everywhere and still listed by nurserymen. **Miracle,** same origin as Conquest, the so-called stoneless plum. Widely planted

as a result of much advertising by the Oregon Nursery Company. **October** (Purple) was said to be a cross between Satsuma and a seedling *triflora.* Introduced by STEPHEN HOYT's Sons of New Canaan, Connecticut, in 1897. Much planted but never important. Still offered for sale by the PICKSTONE Nurseries of Simondium, Cape Town, South Africa.

**Santa Rosa,** a complex hybrid containing a mixture of *Prunus triflora, P. Simonii* and *P. americana,* with the *triflora* characters predominating. Exactly what varieties were involved in the crosses may never be known but the red flesh would indicate that Satsuma played a part. The Santa Rosa and Beauty are not only the two most valuable varieties wherever Japanese plums are grown on a large scale—as in the United States, Southern Europe, North Africa, South Africa, Australia, and New Zealand—but they are the leaders among shipping plums of any variety. There are over 5,000 acres of Santa Rosas under cultivation in California alone. The Santa Rosa was introduced by GEORGE C. ROEDING of the Fancher Creek Nurseries, Fresno, California, in 1906. The Australian rights were secured by J. M. RUTLAND of Kiewa, Victoria, and the South African by H. E. V. PICKSTONE and Brother of Simondium, Cape of Good Hope.

**Satsuma** was one of twelve seedling plums imported from Japan in 1885. It was called the Blood Plum of Satsuma, after the province where it was grown. Introduced by BURBANK himself. The first trees were sold in 1889. Unattractive appearance has mitigated against the Satsuma as a shipping plum; but quality and true worth have given it supreme importance in local markets and home plantings. **Shiro** was a combination of Robinson (*Munsoniana*), Myrobalan, (*insititia*), and Wickson (*triflora*). A seedling of Wickson. Known in South Africa as Shiro Smomo. *Triflora* characters predominate. Planted in home gardens in many states.

**Splendor Prune** was a cross between two varieties of *Prunus domestica,* Pond (Hungarian) and French (Prune d'Agen). Introduced by STARK Brothers of Louisiana, Missouri, in 1886. A successful plum but objectionable as a prune. **Standard Prune,** also a pure *Prunus domestica,* was a cross between the Tragedy and Sugar prune varieties. A fine combination of drying and shipping plum, but more successful as a plum than as a prune. **Sugar Prune** was another *domestica,* being a seedling of French (Prune d'Agen). A heavy producer. Extensively shipped as a plum. Used in California, also, as a prune. Noted for its high sugar content both fresh and dried.

**Wickson,** a *triflora* × *Simonii* hybrid, is widely distributed over the world wherever Oriental plums can be grown. Quality second rate. On the decline in California although in 1940 there were still 2,000 acres under cultivation.

Most of the seventy-eight additional plum varieties, not mentioned here, were undoubtedly planted to some extent as there were scores, if not hundreds, of BURBANK admirers who made a practice

of securing at least one specimen of nearly everything he announced. Also, from around 1900 to 1915, BURBANK's fame was so great that nurserymen, both here and abroad, purchased the exclusive right to disseminate several of the varieties on the omitted list; and since in all cases these varieties were vigorously advertised, it is reasonable to assume that they were planted, and in far-away places some of them may have made good. They are omitted here because we have no evidence that they survived.

**Plumcots.**—This interesting hybrid was produced by crossing the apricot, *Prunus armeniaca*, with the Japanese plum, *P. triflora*. Reciprocal crosses were also made, although the apricot was usually the pollinating parent. Some hybrids had flowers devoid of pistils and often the hybrid seeds were not viable. Many of the trees were weak and almost barren. Others were just "poor producers," or the fruit was discouragingly small, or of inferior quality. Improvements were slow because viable seeds were scarce. Most of the successful hybrids came from plum seeds.

Although the plum-apricot hybrids were announced in 1901, their defects prevented their being offered for sale until several years later. One shortcoming, apparently common to them all, was that they were shy bearers. BURBANK described the plumcot as having "the general form of an apricot and the same general outside appearance, but often more highly colored than either a plum or an apricot, with skin unique — soft, slightly silky-downy, with a shadowy bloom. Seed more often resembles the plum pit, but sometimes vice versa." Eleven varieties were announced.

**Abundance.** From a color photograph it is seen that the flesh resembles the Satsuma plum. The description reads: "The fruit holds the apricot shape and has the short stem and blossom-end of the apricot. In other fruit characters it resembles the plum parent —the serrations of the leaf, however, being those of the apricot." No record of its having been offered for sale. **Apex,** a cross between an apricot and a Japanese plum, was announced in 1911. Fruit large and handsome; trees shy bearers. Now regarded as a Japanese plum. Often met with in California but never commercially important.

BURBANK said of the **Cherry** plumcot: "This beautiful fruit is a curious combination. The fruit itself is a true plumcot, whereas the stem and leaves are distinctly those of the plum." A color photograph shows it to look like a well-colored cherry plum.

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TEXTFIGURE 6. — COVER OF A 16-PAGE CIRCULAR, containing the first important announcement made by Mr. BURBANK after he took back the right to market his productions following the disastrous failure of the Luther Burbank Company of San Francisco, the firm that had contracted some three years before to purchase everything that he could produce. Comparatively few people, even in California, knew that BURBANK had no connection with this corporation—owned no stock in it—and therefore should not be blamed for its sales policies. He permitted the use of his name in much the same spirit that he allowed schools, libraries, and playgrounds to be named after him. Incidentally, the city of Burbank, California, was *not* named in his honor, but for a man of that name who had formerly owned the site.

# 1916-1917

# TWENTIETH CENTURY FRUITS

*At this date*, November 15th, there have been grown and shipped out of the State of California *this season ONE MILLION, ninety-two thousand, two hundred and fifty-six crates* of plums and cherries alone of varieties which were created on my own grounds, *besides* one large shipping firm which could not make a variety report. Need more be said in regard to the value of my horticultural creations?

Some *SEVEN MILLION BUSHELS* of *Burbank Potatoes* were also grown here this season, and unnumbered carloads of *Rhubarb, Prunes*, and other horticultural products can be added for good measure.

LUTHER BURBANK

*Burbank's Experiment Farms* Santa Rosa, California

**Rutland** was named for J. M. RUTLAND of Kiewa, Victoria, Australia, who purchased the rights for this variety for the Southern Hemisphere, including South America. The next year the rights for the United States were sold to GEORGE C. ROEDING of the Fancher Creek Nurseries, Fresno, California. BURBANK believed the Rutland to be a cross between an apricot and the Satsuma plum. It is now definitely regarded as a large hybrid plum of poor quality.

**Quinces.**—Eleven varieties of quinces were announced. Three of them are still in cultivation. One has survived for fifty years, and another for forty-five years.

**Childs** was introduced in 1893 by BURBANK as Santa Rosa, but JOHN LEWIS CHILDS of Floral Park, New York, having purchased the rights to its distribution, named it after himself. A seedling of Rae's Mammoth. Believed to be a third generation cross between Rae's Mammoth and Portugal. **Pineapple** was a seedling of Rae's Mammoth and it was claimed that it was the result of fifteen years of selective breeding. The flesh has a pineapple flavor. H. A. BASSFORD of California sent shipments to eastern markets as early as 1910. The variety is still sold by nurserymen. **Van Deman** was a seedling of Portugal pollinated by Orange. Introduced by STARK Brothers of Louisiana, Missouri, in 1893. Named in honor of H. E. VAN DEMAN, Pomologist of the United States Department of Agriculture. First exhibited at a meeting of the American Pomological Society in Washington, D. C., in 1891, where it was awarded the Wilder Medal. Still a popular variety wherever quinces are grown.

**Raspberries.**—Thirteen varieties were announced, four of them unnamed. There is no record of what names were given them by nurserymen who purchased distribution rights. A native wild black-cap was collected in Mendocino County, California, and named for that county, and another, a *Rubus capensis*, was imported "by way of New Zealand and South Africa and is probably the one that STANLEY speaks so highly of as growing in places on the Dark Continent." The rest were mainly crosses between Gregg, Shaffer and Souhegan.

**Strawberries.**—Although ten varieties of strawberries were announced, none became important. Experiments consisted of crossing many of the common cultivated varieties of the day; also hybridizing numerous wild species from this and other countries. *Duchesnea indica,* a more or less ornamental species supposed to have come from India, refused to hybridize with any of the true strawberries. Species from Norway and Alaska, and two wild forms native to California—*Fragaria chiloensis* and *F. californica*—were used in different combinations with cultivated varieties, without profitable results.

**Patagonia** was a much advertised variety derived from crosses between a Chilean species and Brandywine, Longworth's Prolific, Monarch, and Marshall. BURBANK says: "No striking results were observed until the second generation, when among the

very numerous hybrid seedlings under test was found this unique berry." Testimonials acclaimed its qualities in flattering terms, but apparently it was planted only by amateurs.

**Sunberry.**—Produced in 1905—an $F_2$ hybrid between *Solanum guineense*, the staminate parent, and *S. villosum*, the pistillate parent. Both were inedible species though not poisonous, while the fruit of the hybrid proved to be pleasing to the taste when cooked but less so when consumed raw, unless thoroughly ripe. Introduced by JOHN LEWIS CHILDS of Floral Park, New York, who changed the name from Sunberry to Wonderberry. Lurid advertising caused the plant to be widely planted by amateurs but it never became a market commodity. Still sold as a novelty under different names.

NUTS: —

**Almond.**—A variety of almond named **Palatine** was announced in 1911. It was a seedling of the Jordan grown from meats imported from Spain. Much planted in California over a period of several years, but now rarely met with.

**Chestnuts.**—Six varieties were announced. **California Golden,** a selected seedling of *Castanopsis chrysophylla*, a native chinquapin of the northern coastal region of California, was put out in 1894. It is not certain whether BURBANK referred to the giant chinquapin that occurs among the redwoods, or to the variety *minor*—the golden chinquapin—a shrub 3 to 15 feet high, found along the dry ridges adjacent to Monterey Bay. **Coe**, *Castanea crenata*, 1893, was one of three unnamed seedlings purchased by Judge A. J. COE of Meriden, Connecticut, who called one of them the 18-Month. Soon afterwards the seedlings came into the possession of J. H. HALE of South Glastonbury, Connecticut, who changed the name of 18-Month to Coe, and introduced it under that name in 1897. The other two were named **Hale** and **McFarland.** All three seedlings were dwarfish, the Coe exceedingly so, and in addition, precocious, actually bearing the second year after planting. All three bore sweet nuts, were widely planted, and have survived to the present day.

**Walnuts.**—From 1877 to 1895 BURBANK gave much attention to the improvement of walnuts. He made use of the black walnut of the eastern United States, *Juglans nigra*, the California black walnut, northern variety, *J. californica* var. *Hindsii*, the Persian or cultivated walnut, *J. regia;* the Asiatic species, *J. Sieboldiana* and *J. mandschurica;* the butternut, *J. cinerea;* "and a dozen or more other species." Two of his hybrids became famous. **Paradox** was the result of a cross between *Juglans regia* and *J. californica*, var. *Hindsii*. The Paradox was first mentioned in *Pacific Rural Press*, February 12, 1887, but was first announced in 1893 when the hybrid was offered for sale by BURBANK in the first edition of his *New Creations*. By a typographical error the date was given as 1887 for the original cross instead of 1877, and this date was copied far and wide. DE VRIES, in his *Plant Breeding*, even gives a date as late as 1901. The foliage of the hybrid

is variable, but mostly resembles the *regia,* as do the nuts; the habit of growth is very nearly like that of the *Hindsii.* The trees are characterized by their rapid growth and immense size. For the first few years they flowered but did not produce fruit. At the age of about ten years they began to produce a few fertile nuts; and thereafter they continued to produce, but sparingly. Paradox was recommended as a timber tree and as a rootstock for cultivated walnuts. It was never popular for the latter purpose; its seedlings vary extremely in vigor and in succeeding generations the hybrid vigor is lost; therefore, only first generation seedlings are suitable for this purpose. While the trees have not been planted for timber, the possibilities seem great.

**Royal,** a cross between *Juglans californica* var. *Hindsii* and *J. nigra.* The tree is of noble size, and symmetrical in shape. It resembles both parents but is much larger than either. The nuts are like the *nigra* but larger. Royal is an abundant bearer. A single mature tree may produce a ton of nuts in a season. About 1885 five of the first of these hybrids were planted in and around Santa Rosa, California, in different soils. At least two are still living. One is 3½ feet in diameter at breast height, and 100 feet high, with a branch spread of 125 feet. The Royal will find its greatest usefulness as a timber tree. Introduced in 1906 by the Fancher Creek Nurseries of Fresno, California.

**Santa Rosa Soft Shell** was the result of a cross between two Persian walnuts of unknown ancestry—one locally famous for its heavy bearing, and the other for its thin shells. There were two types of the Santa Rosa Soft Shell, one of which bloomed early and the other late. Both had soft shells, and possessed considerable merit. Introduced by the Analy Nurseries of Sebastopol, California, in 1906.

GRAINS, GRASSES AND FORAGE PLANTS: —

Aside from cactus, BURBANK did not go in heavily for forage plants, grasses, and grains. Beginning about 1907, more than fifty cactus varieties were turned out in four or five years. Approximately half were recommended for forage and half for their fruit, although the latter could also be used for forage if free from spines. As the cactus varieties passed out of BURBANK's hands, a period of wild speculation ensued. Desire for quick profits caused worthless varieties to be sold, thus discrediting the entire industry. By 1916 the craze had subsided.

BURBANK's list of grains and grasses was comparatively short; but the announcement of his grains, in particular, caused him to be severely criticized, state and federal agronomists charging that two or three of them were old, discarded varieties that had been renamed.

**Barley.**—In 1920 BURBANK offered for sale an old, but practically unknown variety—the **Pearl,** a so-called white barley, from one of the Eastern Mediterranean countries. His **Blue Arabian**

**Hull-less** was probably a selection from a cultivated variety in Syria or Turkestan.

**Cactus—forage.**—Cactus enjoyed some success as a succulent feed for poultry and dairy cows. At least there were many published testimonials to this effect between 1906 and 1913. Cattlemen in the semi-arid states of Texas and Arizona had long used wild cactus as an emergency feed in drought years, by singeing off the spines with a blow-torch. BURBANK reasoned that cactus without spines should have unlimited possibilities, and while he produced varieties that were entirely smooth, or so nearly so as to make the name "spineless" no misnomer, cultivated cactus was never planted in a large way. Speculators, by their extravagant claims and high prices, spoiled the industry before it really got started. While cactus for forage never had a fair trial, it is highly probable it would not have been a success. Contrary to general belief it was of slow growth in poor soils and where the annual rainfall was less than ten or twelve inches. Also it had to be fenced to prevent livestock from eating it into the ground. If it had to be planted on fertile soil, fenced, and irrigated, even with high yields, it became unduly expensive for a feed that was mostly water. In short, cactus for forage was an impractical crop, and perhaps never could have succeeded on a large scale.

Of the thirty-four forage varieties announced, the **Avalon** was one of the best in every way. Its history is not known. It may have been an importation. **Burbank Standard** was a product of selective breeding. **Competent** was said to be a second generation, smooth hybrid seedling that was completely free from either spines or spicules. **Fresno**, belonging to the Indian fig class, was a seedling of an old hardy variety named Smith, but unlike its parent and all its seedlings theretofore, the Fresno was claimed to be free of thorns and bristles. **Monterey** belonged to the "Tapuna or pearly-leaved" class of Opuntias, "and has the largest and heaviest pads, slabs or leaves, of any of this class in my whole collection and wholly free from spines except rarely a few short ones here and there." Distributed by American Cactus Farming Company of Los Angeles, California, in 1907. **Myers** was believed to be a natural cross between the "Tapuna" and Indian fig types. Discovered by FRANK N. MYERS near Irapuato, Mexico. Said to be absolutely free from even the least trace of spines.

**Santa Rosa** belonged to the Indian fig class and was BURBANK's highest priced variety. "One leaf of this with the right to sell in the Southern Hemisphere, including all of South Africa, has been sold to JOHN M. RUTLAND of Melbourne, Australia, for one thousand dollars." Distributed here by the American Cactus Farming Company of Los Angeles, California. BURBANK claimed that the **Texas** was "developed here on my farms from a wild, thorny, Texas plant, wholly spineless." **Titanic** was "one of the most remarkable of all known hybrid spineless Opuntias. Leaves or slabs, often three to nearly four feet long, eighteen inches wide and one and one-half to three inches thick."

**Oats.**—Four varieties were announced but none ever became important. Apparently no hybridization was practiced. **Corriente** was a selection from a sample imported from Peru.

**Quinoa.**—**Gautli** or **Quinoa** probably was imported from Brazil or Peru, and first offered for sale in 1887, as an Indian food novelty. In 1918, BURBANK's business ethics having undergone a change, he dramatized the Quinoa by calling it a "new breakfast food, a forgotten cereal of the ancient Aztecs." It had just the right background to attract the gullible, like wheat from Egyptian mummies, beans from the cliff dwellings. Before 1912 BURBANK probably would have hesitated to push the sale of such a plant but in 1918 he took advantage of the free publicity irresponsible writers had given him and promoted it vigorously.

**Rye.**—The two varieties of rye offered probably were selected from Turkish varieties. This was in 1920 and 1921, at a time when he appeared to be using the prestige of his name to sell things of doubtful value.

**Teosinte.**—BURBANK developed a variety of teosinte by "selective breeding" which he named **Early Harvest,** and classified it as *Reana luxurians.* Since it was an annual, recommended for silage, it must have been *Euchlaena mexicana,* sometimes cultivated in the Southern States as a green forage. Evidently it was not a success as it is now unknown.

**Wheat.**—In 1918 BURBANK announced three varieties of wheat, **Quality, Quantity,** and **Super.** The first was declared by agronomists to be identical with an obscure Australian variety called Florence. Although he was roundly criticised for his immoderate statements and high introduction price of $5.00 per pound—$300.00 a bushel—Quality proved to be excellent for certain climates, notably the Dakotas, Minnesota, Idaho, and Washington. Authorities now say that it is "the most widely grown variety of white wheat in the North Central States." Distributed by the Pillsbury Flour Mills Company of Minneapolis, Minnesota.

**Quantity** was an inferior variety that did not survive early tests. It has never been fully identified, although it is believed to have been some old variety. Distributed by H. J. BARKER, nurseryseedsman, Fond du Lac, Wisconsin, in 1918. **Super** was first announced as Burbank but the next year, without explanation, it was advertised as Super. No information was given about its origin. There were the usual excessive claims. It was a good variety but it turned out to be Jones Fife, an old wheat of Russian origin, introduced by the United States Department of Agriculture in 1893. Super was distributed by the State Seed and Nursery Company of Helena, Montana.

VEGETABLES: —

**Of the ninety varieties of vegetables BURBANK offered for sale, his potato was the most famous, and most lasting; while his winter rhubarb, also a real accomplishment, was to him the most profitable.**

At one time or another he endeavored to improve artichokes, asparagus, beans, beets, cantaloupes, casaba melons, celery, chives, corn (sweet), cucumbers, eggplants, garlic, muskmelons, parsnips, peas, peppers, popcorn, potatoes, radishes, rhubarb, squashes, and tomatoes.

**Beans.**—"Almost my first experiment in hybridizing," wrote BURBANK in 1912, "was made by crossing the horticultural pole bean or wren's egg, with another variety of pole bean." He tried also crossing the pole bean with the lima. This was in Massachusetts, when he was about twenty-three and before he produced his famous potato. Forty years elapsed before he again interested himself in bean improvement. Nine varieties were announced, chiefly novelties.

**Chive.**—BURBANK was interested in the chive both for ornament and for food. Knowing the plant to be extremely variable, he obtained a variety from Europe and began selective breeding. The original plants bore dull crimson flowers. After three years of selection a mutant appeared having bright red flowers. Thereafter, "out of thousands of seedlings, nearly all reverted to pink." Turning his attention to improvement of the bulbs, the average size was increased about twenty-fold. It was found to be relatively easy to increase or decrease the odor of the bulbs. Six varieties were announced.

**Corn.**—Corn breeding was started by BURBANK as early as 1870, when he was growing vegetables for market in Massachusetts. He crossed sweet corn in an effort to produce an earlier variety but failed because he did not continue beyond the first generation. He also crossed yellow field corn with Early Minnesota and other sweet corn varieties with the idea of producing a sweet corn with yellow kernels, for which there was a demand. Promising hybrids were obtained but the work was interrupted by his removal to California in 1875.

Much attention was given to ornamental types of corn. His "rainbow" corn with stripes of four colors, later increased to six, was derived from a variegated corn secured from Germany in 1908. At first only two stalks bore colored leaves. Later, after several generations, when a few stalks appeared with colors that pleased him, he multiplied them rapidly by removing and rooting the suckers. All plants were hand-pollinated and isolated from other corn. He always suspected that his original seed was a hybrid between the common green-leafed corn and the old Japanese variegated corn —*Zea Mays variegata*, which had been known for thirty years. A dozen varieties of corn, in all, were introduced, some as food plants for man or beast, and others chiefly for ornament. **Aurora** was an example of the latter, the result of five or six years of selective breeding. A yellow sweet corn, with colorful foliage, the **Burbank**, was an improved Burpee's Early Bantam sweet corn. The rows of grains to the ear were increased from eight to twelve. First called Improved Early Bantam, then Burbank Improved, then New Ban-

tam, and finally, Burbank. **Burbank's Early Sweet** probably was a selected form of Stowell's Evergreen. Selected for production of two ears to a stalk. **Burbank Field** apparently was the same variety introduced as California Field, and two years later renamed Burbank. No information as to parentage. BURBANK's **World Wonder Sweet** was "derived from Golden Bantam through selection and cross-pollination." **Papago** was a tall-growing, yellow, wrinkled sweet corn recommended chiefly for silage and green feed.

**Sorghum Pop.**—Announced in 1917 as a cross between Burpee's Improved Stowell's Evergreen and the gooseneck Kaffir corn, the former being pollinated by the latter. The cross was effected about 1912 after numerous earlier trials had failed. The grains from the hybrid ear were planted, but all the resultant plants except two, were like the pistillate parent. The two exceptions ripened two weeks earlier "and were almost true Kaffir corn with compact, crooked, drooping heads, containing many scattering hard, round kernels, also bearing gooseneck drooping ears, somewhat resembling popcorn. The next season all were planted and a new corn, in many respects resembling white rice popcorn, but with more nearly globular kernels was produced, but the ears were branched or many-fingered and bore kernels, not only on the outside, but on the inside of the ears, producing an enormous number of kernels to the cluster. As these had to be crushed to obtain the corn, selections were made of short, stubby ears, which bore kernels only on the outside." It was recommended as a popping corn.

Agronomists have been skeptical of any such cross having been made and say that the so-called Sorghum Pop is only the old Japanese hulless corn. The cross is a difficult one and has not been repeated, but this does not necessarily mean that it cannot be done. The same objection was made regarding the plum-apricot cross but this feat was duplicated many years later by two experimenters, working independently.

**Peas.**—Forty years ago (1904) BURBANK received an order from J. H. EMPSON, a canner of Loveland and Greeley, Colorado, for a particular type of pea for his trade—something small like the Petite Pois of France, of uniform size, sweet, and reaching the desired maturity all at the same time so that harvesting and hulling could be done by machinery. The contract called for filling the order in six years; but by growing two crops in a season, BURBANK fulfilled his obligation in half the time. The improvement was brought about through six generations of selections, no cross-pollination being involved.

Three peas were submitted for the selection experiments—the Admiral, Alaska, and Horsford, all having been used for canning. The Alaska and Horsford were soon eliminated. The Admiral yielded five sub-types, graded according to size of pea, and all were sold according to number as **Burbank Admiral.** A letter from the company, dated March 31, 1943, verifies the foregoing statements and adds that they have grown from 1,500 to 2,000 acres of the peas, annually, since 1908.

**Peppers.**—Numerous crosses were made with Chilean and Mexican forms of peppers on our cultivated varieties. Four varieties were announced but they were of no particular value.

**Potatoes.**—BURBANK's most lasting fame, no doubt, will always be associated with the potato which bears his name. As a young man of twenty-four, BURBANK was a truck gardener near the village of Lunenburg, Massachusetts. As a grower of vegetables for market he was keenly alive to the importance of improvement in various directions, and hybridized a few plants with this object in view. When, however, he planted the fateful seeds that produced his potato he had no ideas, grandiose or otherwise, for bettering the crop. On the contrary, he planted through curiosity—to see what would happen. Early Rose potatoes seldom flowered, so when a seed-pod chanced to appear it was an object of interest. Most observers were content to wonder and pass on, but young BURBANK kept the single capsule that he had seen and planted the seeds, with astonishing results. BURBANK refers to his potato as a discovery—something he came upon by chance. Be this as it may, his good fortune fired his imagination; he resolved to devote his life to the improvement of plants in ways suggested by DARWIN, not merely waiting for chance to throw improvements in his way. Using the proceeds from the sale of his potato, he went to California and in a few years entered upon his lifework. His further efforts with potatoes had no conspicuous results. The Darwin potato, *Solanum Maglia*, a wild, yellow-fleshed species from Chile, was crossed with the common potato. Of the many curious hybrids that resulted, none was valuable enough to be introduced. The *S. Maglia*, however, normally produced unusually large seed-pods; and one of the hybrids bore pods with a tomato-like flavor, which was introduced for its fruit. Crosses were also made with *S. Cammersoni* from the Mercedes River section of eastern Argentina; the Squaw potato from the Southwest, *S. Jamesii*; and an unidentified Mexican species. Finally, about 1895, he hybridized a Pacific Coast variety known as the Bodega Red with the Burbank. This hybrid was announced but never introduced. Eight varieties were advertised.

The **Burbank,** a first generation open pollinated seedling of the Early Rose, originated in BURBANK's garden near Lunenburg, Massachusetts, in 1873, and was introduced in 1876 by JAMES J. H. GREGORY, a seedsman of Marblehead, Massachusetts, who called it Burbank's Seedling. From a single seed-pod BURBANK planted twenty-three seeds. Each grew and produced a cluster of tubers. All but two of the clusters were worthless. One of these was later discarded, while the other was kept and multiplied as rapidly as possible. In 1876 the entire stock was sold for $150 to Mr. GREGORY, who permitted BURBANK to take ten of the tubers with him to California. In his catalog for 1876 GREGORY extolled the merits of the new potato, saying that unlike its parent it is white skinned, instead of pink; that it outyielded all other varieties by actual test; had but few eyes which were sunk but little below the surface; and that "in quality it is firm grained, of excellent flavor either boiled

or baked, is dry and floury, is fine, is all that can be desired," and "that it ranks between the very early and very late varieties."

The Burbank potato has had a truly remarkable career. Adaptable to extremes of soil and climate, it was widely distributed. After seventy years, under this name, it is still important in certain districts—for example, the great Delta region of California—but still more so in the home gardens of half the states of the Union. Today there are several different strains of the Burbank. The Russet Burbank, known to the trade as Idaho Baker, is one of them. Ninety per cent of the crop in the well-known district near Twin Falls, Idaho, in 1940 were of this variety. Others are the Netted Gem, Klamath and the Pride of Multnomah.

**Rhubarb.**—BURBANK performed a notable service with a food plant by importing a winter-growing rhubarb from New Zealand and improving it by selective breeding and by crossing it with "the various races of ordinary rhubarb, in particular with the variety known as the Burbank Giant. The crosses were made mostly by using the winter rhubarb as the pistillate parent, but reciprocal crosses were also made. The progeny, as is often the case with hybrids, showed great vigor of growth."

The improved, winter-growing rhubarb was widely grown in countries with a mild climate as in California, England, Italy, and South Africa, and was even taken back to New Zealand and Australia. Several varieties were announced over a period of twenty years, but not being hardy, they were not useful in cold climates.

BURBANK voiced the theory more than once that plants removed from one hemisphere to another, especially to places where seasons are reversed, tend to change their growth habits. This was the explanation he gave for the behavior of the Australian rhubarb which he obtained from New Zealand. H. S. WILLIAMS, chief editor of his autobiography (who should have known better), piled sophistry upon sophistry in an effort to prove that the rhubarb, when removed from the Antipodes, was compelled to follow the calendar rather than the immutable seasons. BURBANK casually mentioned this theory but WILLIAMS devoted pages to it. Nonsense of this kind tended to discredit BURBANK with men of science.

The facts appear to be that a certain type of rhubarb had always grown in the cool season of the winter months—June to September in Australia and New Zealand, and when brought to California it still grew in the winter months which, in this hemisphere, are December to March. We have many plants that demand a low temperature for their best growth; the Australian-New Zealand rhubarb is merely a pronounced example of this kind.

**Australian Crimson Winter.** The original stock was obtained from D. HAY and Son of Auckland, New Zealand, about 1895. Insignificant at first, it was rapidly improved by selection alone. E. J. WICKSON, Professor of Horticulture in the University of California during the BURBANK era, in his book *California Vegetables* (p. 279), said of it:

"The Crimson Winter, introduced from Australia [?] by LUTHER BURBANK about 1895, and sold by him to the trade in 1900, has revolutionized rhubarb growing in California by completely reversing the market season. This variety and its improvements by Mr. BURBANK and by others who have practiced selection since he sold it out, notably by J. B. WAGNER of Pasadena [California], has multiplied the rhubarb acreage of the state and vastly increased the serviceability and commercial suitability of the plant. It has precluded forcing in California and promises to render forcing unprofitable even in the wintry parts of the country because of the large supplies of open air rhubarb which are available for shipment from this state at all times of the year when the summer varieties grown in wintry climates are unproductive."

Because growers have made their own improvements, developed new varieties best suited to their own soils and climate, and given new names to these variants, the Burbank rhubarbs, even in California, are now rarely heard of, although some modern varieties are probably lineal descendants. JOHN LEWIS CHILDS of Floral Park, New York, was one of the early distributors of BURBANK's rhubarbs.

**Squashes.**—Work with the squash began as early as 1873 and consisted of hybridizing experiments with the Canada crook-neck, which was then popular. No important improvements were effected. Many years later squash seeds were received from a collector in Chile. As a result of hybridization and selection, two varieties were announced. Gourds from Australia and South America were experimented with but no varieties were perfected.

**Tomatoes.**—Some hybridizing and much selection was done with tomatoes. Seven varieties were announced. One, a special purpose variety—for preserving—was carried in stock by a nationally known seed company for more than ten years. This was the variety called **Burbank Preserving.**

ORNAMENTALS: —

Of the several hundred ornamental plants introduced by BURBANK, the Shasta daisy was undoubtedly his greatest contribution. This flower has travelled around the world, being widely planted in European countries, South Africa, and elsewhere. In modified form it is still as popular today as it was when first announced nearly forty years ago.

For sheer number of varieties developed through hybridization and selection, within a single genus, *Amaryllis, Hippeastrum* and *Crinum* hybrids easily stand at the top of his list of introductions, followed by lilies, including *Hemerocallis;* then by Watsonias, poppies, gladioli, dahlias, and roses, somewhat in the order named, though none ever became so famous as the Shasta daisy.

The average life of a flowering annual, or even a bulbous or herbaceous perennial—the period dealers carry it in stock—rarely exceeds ten years; then usually it is superseded by an improved type under another name. Dealers are ever on the lookout for new

things to offer their customers; for one reason, because they are more profitable; and their breeders strive to meet this demand.

Scores of BURBANK's hybrid ornamentals were sold to the trade without names. The dealers supplied names of their own selection, and thus the origin of the varieties was lost, so far as credit to BURBANK is concerned. Certainly it is now impossible to trace these transactions.

**Amaryllis.**—*Hippeastrum, Crinum,* and *Sprekelia* are all included under this heading. BURBANK gave active attention to this group throughout twenty to twenty-five years and watched some of his hybrids even longer. The Hippeastrums were the first group experimented with — *H. Johnsonii, H. vittatum,* and *H. reginae.* The *H. Johnsonii* is itself a hybrid, so that a cross between it and *H. vittatum* (one of BURBANK's early successes), represented a union between a hybrid and one of its parents. In the next generation *H. aulichum* was introduced and then *H. reginae,* the other parent of *H. Johnsonii.* Beginning with the fifth generation, BURBANK tells us: "several other species of *Amaryllis* were introduced into the combination." There were then crosses and re-crosses among the various hybrids. After about twelve years, he says, his "colony of mixed hybrids . . . . showed wide departures from any of the ancestral forms." This is the history of his new race known as Giant Amaryllis.

The Amaryllis hybrids were then crossed with *Sprekelia* and *Crinum.* The *Hippeastrum-Sprekelia* cross was at least a partial success: "I have worked on the *Sprekelia* more or less for twenty years. . . . but I succeeded only once in hybridizing the plant, with the production of fertile offspring." Also "only a single hybrid of this union bloomed, but from this a number of seedlings were grown. The hybrid offspring of these plants of different genera had long, narrow, strap-shaped leaves much like those of *Sprekelia* (the pollen parent), but the blossoms were very much larger than those of that plant, and they had very curiously twisted petals, unlike either parent."

Now comes the controversial claim to having hybridized successfully the *Amaryllis* with the genus *Crinum.* "Interesting hybrids were produced by crossing the *Crinums,* not with the members of the Hippeastrum colony (this proving impossible), but with the form of true Amaryllis known as *Amaryllis Belladonna.* The hybrids thus produced were a curious lot. They seemed undecided whether to take on the flat, strap-shaped leaves of the *Amaryllis* or the tunicate leaves of the other parent. The compromise led to the production of a leaf with a long, curious neck." We are not told which species of *Crinum* he used; it might have been either the *americanum, amabile (augustum), asiaticum, Moorii,* or *longifolium, for he tried them all.*

*At this late date,* who can say whether the *Amaryllis-Crinum* cross was really effected? Although some have doubted, it was probably made. Dr. GEORGE H. SHULL, who spent nearly five years in Santa Rosa (1904-1909), checking BURBANK's experiments for

the Carnegie Institution of Washington, supports this belief, at least passively. He has kindly supplied a paragraph from his unpublished report, with the comment that he could "only vouch for the fact that the following statement had Mr. BURBANK's approval."

"Another noteworthy hybrid which Mr. BURBANK produced was between *Amaryllis Belladonna* and *Crinum americanum*, the Amaryllis being the seedling parent. While these Amaryllis-Crinum hybrids are of little economic value, they are of much interest scientifically. The leaves of the Amaryllis are flat and strap-shaped, and those of the Crinum are curved and overlapping or rolled together in such a manner as to form a distinct neck to the bulb. In the hybrid the leaves seem to be distinctly intermediate between these two types, being more or less curved at the base and becoming strap-shaped above, sometimes exhibiting a distinct offset between these two portions of the leaf. The flowers are intermediate between the two parents, being smaller than the *Amaryllis Belladonna* and more tubular, but varying through light pink to deep rosy crimson like the Belladonna lily. These curious and graceful hybrids multiplied quite rapidly and are easily grown, but have never borne any seed. Efforts to cross them with the two parents have also been without result. None of these hybrids have been distributed, and only a few remain in existence at the present time."

Apparently only eight or ten varieties of amaryllis were introduced, but a large number of hybrids were announced—136 at one time—and sold without names. Likewise, according to a statement by BURBANK, crinum hybrids were sold without names and without advertising. So far as can be determined, all have now disappeared from the trade or have been further improved and their original names lost.

**Martinique**. This variety, announced in 1909, was considered to be the finest and most unique hybrid between the Jacobean lily, *Sprekelia formosissima* and *Amaryllis* (Hippeastrum) *vittate*. "The flowers are a fiery crimson—like those of the Jacobean lily but very much larger. The blooms are nine inches in diameter and are even more remarkable for their long, curious, twisted petals, which give the flower a strange appearance and which is not found anywhere among the *Amaryllidaceae*. The leaves are pale green, upright, strap-shaped, one inch wide and eighteen to twenty inches long." He added that seed capsules were produced abundantly but rarely with viable seeds.

**Canna.**—Ten varieties of canna were announced, of which **Burbank** and **Tarrytown** were the most important. The latter was a hybrid between a canna of the Crozy type and the wild swamp canna of Florida, *Canna flaccida,* and the Burbank probably had the same origin. The Tarrytown was rated as an orchid type and apparently was very popular for a few years after its introduction in 1895. It was awarded a gold medal at the Pan-American Exposition at Buffalo, New York, in 1901.

**Clematis.**—The well-known *Clematis Jackmanii* was pollinated by *C. coccinea,* and "various other species including *C. Davidiana,*

*C. Freemontii, C. ligusticifolia, C. Douglasii, C. verticillaris, C. occidentalis, C. Fortunei, C. Viticella,* and others, no attempt being made to keep the various crosses separate."

The varieties **Ostrich Plume, Snowdrift,** and **Waverly,** which BURBANK termed his new race of *Clematis,* were the product of crosses between *C. coccinea* and *C. crispa.* Seedlings of the *crispa* were pollinated by various species and showed a great amount of variation in both color and texture of the flowers, but in their general habit, and their herbaceous stems, the hybrids seemed uniformly to follow the seed parent. Introduced by J. C. VAUGHAN of Chicago, Illinois.

**Crinum.**—"I have grown about twenty species, some of them of tropical origin. Numerous crosses were made among these species until I had a crossbred strain of Crinums of ancestry as complex as that of my Hippeastrums." The seed parent of most of the hybrids was *C. americanum,* but a few were from seeds of *C. amabile* (*augustum*) and *C. asiaticum.* The traits of the temperate-zone species appeared to be dominant.

**Dahlia.**—Experiments designed to improve the dahlia were of three kinds: crossing cultivated varieties with the cactus dahlia of Mexico, *Dahlia Juarezii,* production of a fragrant dahlia, and attempts at hybridizing the dahlia with the related genus, *Bidens atrosanguinea,* the so-called black dahlia. The first project resulted in several double-flowered varieties; but the perfectly doubled forms were seedless.

A strain with a faint but pronounced fragrance, "comparable to that of magnolia blossoms," was developed by repeated selection. Fragrance, however, not seeming to be "compatible with other desirable traits of flower and form, none of the fragrant-flowered seedlings were named or introduced, except three or four, which were purchased by J. C. VAUGHAN of Chicago," [Illinois], who presumably introduced them under names of his own.

The black dahlia (*Bidens atrosanguinea*) refused to hybridize with true dahlias; but the flowers were reported to have been doubled in size, extra petals added, and the color improved—all by selective breeding.

Twenty varieties of dahlia were named and offered for sale. Two of these—**Lavendera,** introduced in 1918, and **Sebastopol,** announced about 1895, remained a long time in the public favor and, indeed, may yet be found in cultivation.

**Daisies.**—Creation of a new race of daisies by a process of breeding was one of BURBANK's outstanding accomplishments. The foundation stock was a form of wild *Chrysanthemum,* presumably from New England, but possibly from the Mt. Shasta region of California; this and its seedlings were combined with *C. maximum* and *C. lacustre* from Europe and *C. nipponicum* from Japan. At the outset, improvement by selection alone was tried with the wild daisy, but while there was considerable variation there was no marked advance toward betterment. Pollen of the *C. maximum* was then used to fertilize the most promising of the seedlings.

These hybrids being unsatisfactory, he next introduced *C. lacustre,* obtaining the seeds from a dealer in Germany. This he used as the pollen parent on the best of the hybrids. By selection for "five or six years," he secured a daisy obviously superior to any one of the original forms as to size and beauty of flower and fully equal to any of them in ruggedness and prolific blooming but the flowers still lacked that quality of crystal whiteness he held as an ideal.

The final step in the breeding program was then taken by bringing in the fourth and last member of the combination—the Japanese species, *C. nipponicum.* In most respects, this daisy was inferior to other species, but it had a pure white flower, the only quality that was lacking in all the others. When this was in bloom it was used as the pollen parent in crossing it with the *Leucanthemum-maximum-lacustre* hybrid. The rest of the story was one of continued selection, until at last one was found "with flowers as beautifully white as those of the Japanese and larger than the largest of those that the hybrid plants had hitherto produced." The work was begun about 1884 and completed in 1901. The perfected flower was given the name of Shasta Daisy.

For all practical purposes the Shasta became a new race of daisies. It was an immediate success in this and other countries and is as popular now as it was forty years ago. Of course, it has been greatly improved; but it is still found in flower gardens everywhere in its original form, as first introduced. Seven varieties were introduced, of which **Alaska** and **Westralia** were the most prominent.

**Gladioli.**—During his lifetime BURBANK introduced over forty varieties of gladioli. He says he first began experimenting with them about 1882. His first variety, although sold in 1889, was not announced until 1892. His last was announced in 1925. The old-time variety, or species, *gandavensis,* and the then new variety America, played important parts in the early hybridization experiments.

BURBANK really made some valuable gladiolus contributions; several of his varieties remained in the trade ten to twenty years or even longer. His first success was a type with a hyacinth-like flower arrangement. This was lost by freezing after being sold. Discouraged by the ravages of garden pests, chiefly gophers, the entire collection of breeding stock was sold to H. H. GROFF of Simcoe, Ontario, Canada. GROFF added many more varieties to the list of fifty-seven already announced by BURBANK.

**Godetia.**—BURBANK is credited by botanists with having introduced a new species of *Godetia* from Patagonia. His Chilean collector found the plants growing wild in Patagonia. In announcing the plant in 1910 it was given the variety name of **Burbank's New Lavender Trailing** godetia. Botanists accepted the name *G. Magellanica,* which BURBANK had suggested as only a provisional name, for the species. The flowers were lavender-colored, a color not before seen in godetias. It was said that at the first of the

season the plants were trailing in habit, but when blooming became upright, attaining a height of two feet.

**Hemerocallis.**—Four varieties of day lilies were announced as hybrids, but their parentage was not given. **Burbank** was described as being thirty-four inches tall, and the flowers yellow with rather narrow segments. STOUT says, "Very like *H. Thunbergii.*" Distributed by CARL PURDY of Ukiah, California.

**Lilies.**—For thirty years or more, beginning about 1875, BURBANK carried on an extensive breeding program with lilies. Besides the true lilies he also worked with *Agapanthus,* the so-called lily of the Nile or African lily; *Alstroemeria,* the so-called lily of Incas, a bulbless lilylike plant with yellow flowers; *Hemerocallis* or yellow day lily; *Herbertia; Richardia* or calla lily; and *Tigridia,* or tiger lily. But it was with the true lilies that he conducted what even today is considered to be, probably, the most extensive lily-hybridizing project ever undertaken. It involved crosses between Old World and eastern American species with wild forms indigenous to the Pacific Coast. The latter were successful parents. CARL PURDY, an authority on Pacific Coast lilies, considered the successful hybrids to be chiefly from crosses of *Lilium pardalinum* with *L. Washingtonianum, L. Humboldtii, L. Parryi,* and *L. maritimum.* The start was made with the wild *L. pardalinum* which was cultivated and the seeds planted. Extreme types of these seedlings were selected and cross-fertilized, the process being repeated several times. Variation in the offspring was wonderful to behold. In a collection of an estimated four hundred hybrids, every intermediate form could be found, from giants nine feet tall to dwarfs from six inches to a foot in height, while the flowers ranged in color from yellow centers and scarlet tips through orange to light yellow centers with pale red tips. "These variations served as a basis for succeeding work", continued PURDY, "for when by repeated cross-fertilizations a form begins to break, it is more susceptible to the influence of the pollen of another species.

"Using some of these varieties of *Lilium pardalinum* as pistillate parents, Mr. BURBANK crossed them upon the following lilies: *L. auratum,* many varieties; *L. Batemanniae, L. Brownii, L. candidum, L. Catesbaei, L. chalcedonicum, L. elegans, L. Humboldtii, L. longiflorum, L. Martagon, L. maritimum, L. Parryi, L. parvum, L. speciosum, L. superbum, L. tigrinum, L. Wallichianum, L. Washingtonianum, L. purpureum,* and some other Pacific Coast lilies were also used as the pistillate parents for a few thousand crosses. . . ."

In retrospect, after half a century, this experiment in hybridization still appears to have been boldly conceived and audaciously executed, especially since knowledge of breeding was limited at the time and since the experimenter was compelled to make his ventures pay cash dividends. From a scientific viewpoint the experiment yielded much information on the possibilities of commingling the characters of an interesting group of American species and at least pointed the way toward introducing some of their virtues, such as perfume and hardiness, into Old World varieties.

According to GEORGE L. SLATE, author of *Lilies for American Gardens* (1939), none of the BURBANK hybrids survived weaknesses that may yet be overcome by a sustained process of breeding to eliminate the virus disease and adapt them to a wide range of soil and climatic conditions.

BURBANK's lilies—with one exception—were sold as hybrids without variety names. The one exception, the **Burbank**, a hybrid between *Lilium pardalinum* and *L. Washingtonianum*, probably was named by the introducers, J. J. H. GREGORY and Sons of Marblehead, Massachusetts. The hybrids were widely disseminated both in this country and in Europe, but they seem to have succumbed to what is now known as mosaic disease, or become so weakened that the varieties gave a poor account of themselves and were eliminated by discouraged growers.

**Nicotiana.**—Crosses were made between *Nicotiana alata*, *N. glauca*, *N. purpurea* (var. *grandiflora*?), *N. suaveolens*, *N. affinis* (var. *grandiflora*?), *N. colossea* (*tomentosa*?), and perhaps others. The crosses were effected with much difficulty; all hybrids were infertile and had to be propagated from cuttings of stem or roots. No varieties were introduced.

**Nicotunia.**—The cross that produced this novel hybrid was between *Petunia hybrida* var. *grandiflora* and *Nicotiana wigandioides* var. *rubra*, the petunia pollen being used to fertilize the *Nicotiana*. No seed was ever produced in the hybrids, but they were readily propagated from cuttings. Mostly they were semitrailing annuals, the tobacco characteristics predominating; yet when held over until the next year they soon began to show the influence of their mixed heritage. The entire stock was accidentally lost by freezing.

**Poppies.**—BURBANK considered the production of a blue-flowered poppy to be one of his minor triumphs as a plant breeder. This was a development of the corn or Shirley poppy, *Papaver Rhoeas*, through several years of selection. The first epoch in selection ended with the introduction of two varieties of improved Shirley poppies. The flowers were double or semi-double, and the petals were crimped and showed black spots. Selection now took a new direction, finally resulting in "a strain in which about one-third of the plants bore flowers of various shades of blue, some smoky or seemingly mixed with black pigment, and others fairly clear, if not bright, blue color." The blue color was never firmly fixed; some of the seedlings always tended to revert to the more familiar colors. A crimson *Eschscholtzia* or California poppy was similarly developed from the common wild yellow form, by a process of selection. He also experimented with the wild *Papaver californicum*, *P. glaucum*, *P. somniferum*, and *P. nudicaule*. Twenty-four varieties were introduced.

**Primroses, Evening.**—Selections were made from a wild evening primrose from Chile, which he called *Oenothera* "America." It was not offered as a new species but as a new variety. He later hybridized

this with *O. acaulis* or *taraxacifolia*, and produced a number of intermediates.

**Richardias.**—Marked results followed selection experiments with calla lilies, *Richardia albo-maculata* and *R. hastata*. Then he hybridized the two, making reciprocal crosses. Later *R. Elliottiana*, *R. Pentlandii*, *R. melanoleuca*, *R. Nelsonii*, and *R. Rehmanni* were introduced and hybridized with one another and with *R. albo-maculata* and *R. hastata*. There was wide variation in both form and flower among the hybrids. A dozen varieties were introduced, one of them, the **Fragrance**, being noted for its pleasing perfume.

**Roses.**—Experiments with roses began in the middle eighties or earlier. The first variety was sent out in 1898. Several more followed up to 1918—just how many is not known, but a dozen or more; some were unnamed seedlings, and some may have been sold without being announced. Seeds from a Hermosa type of Bourbon rose, "which rarely bears seed, even in California," were planted and the resultant seedlings hybridized with Bon Silene and others.

Rambler hybrids were produced by crossing the Crimson Rambler with the Empress of India, the Cecile Brunner and "dozens of others." Other breeding stocks were: the white and buff Banksias, *Rosa gymnocarpa*, *R. chinensis*, *R. rugosa*, and General Jacqueminot, which were hybridized with Hermosa. Direct and reciprocal crosses between the Persian rose and the Tea, Perpetuals, Banksias, Multifloras, Bourbons, and Wichurianas were complete failures, it being explained that the Persian is completely sterile and therefore never forms viable seeds. BURBANK did not know the exact ancestry of his hybrids, the pedigrees in a few generations becoming so complicated that he did not keep a record of them.

**Burbank**, named and announced by the distributor, W. ATLEE BURPEE of Philadelphia, Pennsylvania, in his catalog for 1900, was awarded the gold medal as the best bedding rose at the Louisiana Purchase Exposition at St. Louis, Missouri, in 1904. Survived for many years; re-introduced by STARK Brothers of Louisiana, Missouri, about 1936.

**Santa Rosa**, a second-generation seedling of Hermosa × Bon Silene. Precocious blooming habit of Hermosa. Introduced by BURBANK himself in 1888. This was the first of his roses to be announced.

**Sunflower.**—Apparently hybridizing experiments with the genus *Helianthus* were confined to types and varieties of the common sunflower, *H. annuus*, with an admixture of *H. californicus*, with the object of increasing the size of flower and the yield of seeds.

**Teosinte.**—**Burbank's New Rainbow** was the only variety announced. Presumably a cross between teosinte and variegated corn, for BURBANK indubitably did make corn-teosinte crosses, as attested by numerous color photographs of the hybrids.

**Tigridias.**—*Tigridia Pavonia* and its varieties crossed readily with each other and with *T. conchiflora* and *T. buccifera*. Species

of the allied genus *Ferreria*, from the Cape of Good Hope, were also successfully hybridized with the tigridias, but efforts to introduce another genus into the combination—*Herbertia platensis*—was a failure. Five varieties of tigridias were announced.

**Tomato.**—A cross between the common tomato, *Lycopersicum esculentum*, and *L. pimpinellifolium*, the so-called currant tomato, was announced as an attractive ornamental.

**Verbenas.**—BURBANK'S varieties of fragrant verbena—**Elegance, Fragrance,** and **Mayflower**—apparently were produced by selection alone, through several generations; during which time the flowers were considerably increased in size and the fragrant quality fixed to his satisfaction. This quality, however, was never so firmly fixed as to permit of propagation by seeds. **Mayflower**, the original fragrant variety, originated about 1895, was sold without announcement, to JOHN LEWIS CHILDS of Floral Park, New York, in 1901.

**Watsonias.**—Several crosses were made between *Watsonia Ardernei* and *W. coccinea,* and their varieties. These crosses and re-crosses resulted in multiple hybrids from which many varieties were selected and introduced from 1908 to 1917. The principal production from *Watsonia* was a pure form with double flowers, wherein the doubling was "brought about, not by the transformation of stamens, as in the case of a double rose, or dahlia, but by growing a new circle of petals outside the old ones . . . . sometimes spoken of as supernumerary doubling, to distinguish it from the usual type in which each new petal takes the place of a stamen." Perhaps the most interesting development from the viewpoint of science was the successful crossing of *Watsonia* with a *gandavensis* type of *Gladiolus*. The hybrids were weak and unsatisfactory, however, and eventually died from "gladiolus diseases." More than a dozen varieties of *Watsonia* were announced.

## XX

## AFTERMATH

WHEN the press of the nation on April 11, 1926, carried the announcement that LUTHER BURBANK had passed away the question in every reader's mind was, "What is to become of his work?" It was taken for granted that he had some sort of organization that would carry on. The public never has understood that he had no organization — that he worked alone and had no successor. The immediate question that his widow had to find an answer for on that fateful April day was what to do at once. The season's planting was already well under way, for spring comes early in California, but much yet remained to be done. Mr. HALL, who was just finishing his biography of BURBANK, *The Harvest of the Years*, was still at hand and became a valuable helper. He was quartered in the "Studio", an apartment over the garage where he slept and worked.

With the aid of HALL's skilled hands BURBANK's last seed catalog was issued.[126] Presumably BURBANK had already assembled most of the material for the announcement, for it bears a close resemblance in both style and subject matter to catalogs previously issued. Only the introductory statement remained to be written. The brochure also contained an advertisement of the new BURBANK book by HALL which was offered for sale by the Luther Burbank Experiment Farms at Santa Rosa. Then the workers put their heads together and issued a second posthumous catalog under the title, *Final New Fruits Bulletin*, an eight-page announcement of several new fruits that had not before been offered — a pear, ten plums, one nectarine, one prune, and some unnamed hybrid chestnuts. The editors, not being horticulturists, confined their remarks to descriptive statements taken from BURBANK's notebooks.

It should be explained here that WILL HENDERSON, garden foreman, who had been in BURBANK's employ for four years, was perhaps the only person left who had much technical knowledge of the enormous collection of fruits and flowers; and he left shortly, as a result of a disagreement, to go into business for himself. Under the circumstances it seemed to be necessary and advisable to close out the business entirely. The bulletin *Burbank Seeds* carried the following announcement: "No one can 'carry on the work of LUTHER BURBANK.' All we could do as regards his seed and bulb business was to follow out the plans he had made for 1926 and for this Bulletin; that much we have done.

[126] BURBANK Seeds, 1926.

"Regarding the perpetuation of his work of plant-breeding and experimentation, his own wishes have been followed and his own plans carried out. To this end Mrs. BURBANK has offered to transfer Mr. BURBANK's experiments, planting plans, and existing experimental trees and plants, together with ample land and equipment for research and experimentation, to the Leland Stanford University of California. The University has expressed a strong desire to accept the offer, and will do so if and when an endowment can be raised to make possible the fulfillment of the plan contemplated."

But nothing came of these plans. President JORDAN of Stanford was friendly to the idea and he was supported by Judge LIEB, a Trustee of the university. Others were openly or covertly hostile, but mostly there was indifference. Apparently the institution made no serious effort to find a patron to donate the million or so that was thought necessary for an endowment. Friends of the idea approached the authorities of the University of California but received no encouragement. Previous to BURBANK's death the Santa Rosa Chamber of Commerce proposed two plans to him for setting up a permanent memorial, one of which called for the purchase of the Sebastopol tract of thirteen acres, where most of his experimental material was grown, but family influence was brought to bear upon him to reject both of them, although he is said to have been greatly disappointed that one or the other could not have been carried out. After his passing, the citizens of Santa Rosa did not renew their efforts in this direction.

After completing the season's work of 1926 with such experienced help as remained, Mrs. BURBANK decided to dispose of everything except land and buildings. The STARK Brothers Nurseries and Orchards Company of Louisiana, Missouri, became the purchaser. The contract was in two parts. On August 23, 1927, they contracted for "the name and good will of the bulb business, all seeds and bulbs in stock, names and index cards of all customers; implements, supplies and all catalog material; cuts, pictures, photographs, variety names, copyrights, trade marks, phrases and slogans used in the business."

Another contract executed September 6 called for "the exclusive right to all uncompleted experiments with fruits at Sebastopol for a period of ten years, including those fruits mentioned in the '*Final New Fruits Bulletin*' which was issued in 1927, but excluding the Royal and Paradox walnut trees." The old Royal tree is at Sebastopol while the Paradox is in the garden at Santa Rosa. STARK Brothers made some arrangement later that gave them the right to market the nuts from these trees.

The second contract also included the right to certain grafts and buds sent to the Armstrong Nurseries at Ontario, California, to be propagated, but STARKS agreed to pay a royalty for every tree sold and to guarantee minimum royalties of $1,000 a year for a period of ten years. STARKS also reserved the right to renew

either one or both of the contracts for terms of five, ten, fifteen, twenty-five, or forty years.

From down payments and guaranteed royalties Mrs. BURBANK realized a total income of $27,000 for the first ten year period. Other royalties swelled that amount.

STARK Brothers' investment in the BURBANK fruits evidently proved to be profitable as in 1937 they exercised their option and renewed the contract for another ten years. The seed and bulb business may have paid out but it is significant that that particular contract was not renewed.

When STARKS took charge of the "Burbank Experiment Farms" in 1927 they employed a competent horticulturist, Mr. JOHN T. BREGGER, to make a careful study of the vast collection of hybrid fruits that BURBANK had under test in the orchard at Sebastopol. Up to date (1942), thirty-four new varieties have been selected as worthy of introduction. These have been given names and patented in Mrs. BURBANK's name under the new United States Plant Patent Law, and STARKS given the right to sell them. Presumably Mrs. BURBANK will continue to collect royalties as long as STARKS see fit to keep their contract alive.

The "Burbank Experiment Farms" consisted of the thirteen-acre Sebastopol place — his main grounds; the old home place of three acres (where he lived with his mother for thirty years); and the "new" place, a four-acre tract across the street to the north where he built a two-story brick residence in 1907, and where he was domiciled to the end of his life. After his passing the unoccupied portions of both tracts were divided into residence lots. The brick residence was converted into a "Burbank School of Business" by parties who leased it for the purpose. Mrs. BURBANK then moved back to the old, original BURBANK dwelling which stands in the garden where BURBANK first attained fame from his experiments. The ancient structure was overhauled and rehabilitated. The interior of the three principal first-floor rooms was finished in walnut cut from Royal and Paradox trees, two of BURBANK's notable hybrids which had grown too large for the garden space and had to be removed. The reception room and the living room were thrown together and in them many BURBANK relics of a personal nature are displayed. The walls are covered with autographed photographs of notables who had visited him. His desk is kept just as he left it with loose papers and a photograph of THOMAS EDISON, which he had been examining the last time he sat there. Open book cases contain his favorite books. Visitors are admitted for a small fee, the proceeds being given to a local charity.

On the south side of the house is a patio with the famous BURBANK greenhouse, and the studio, forming two of its sides. Near the center of this brick-paved enclosure is an old apple tree which bears several varieties of apples, all hybrids developed by BURBANK and grafted by him on the various branches. In fact he was engaged in grafting one of the branches when he was seized

with his final illness. Considerable sentiment, therefore, attaches to the tree as this was the last piece of work his hands performed.

The adjacent garden of about an acre and a quarter, all that is left of the larger area where BURBANK labored for fifty years, was leased to an Eastern seed firm until 1933 when it was donated to the Santa Rosa Junior College. The seed firm used it to grow an attractive collection of flowers which they allowed the swarms of visitors to believe had been originated by BURBANK.

Since the College came into ownership of the property the Service Clubs of Santa Rosa have erected an attractive gateway, as a tribute to the memory of BURBANK. Nearby, on the small tract reserved by Mrs. BURBANK for residence purposes, stands a noble cedar-of-Lebanon tree, beneath which BURBANK was buried. Intentionally there is no headstone or other marker, the tree, which he himself planted, being his monument. The only other large trees in the yard — an area less than an acre in extent — are a fine specimen of Monkey-puzzle (*Araucaria imbricata*) fifty to sixty feet tall and a Paradox walnut seventy to eighty feet in height.

The College uses the garden, and a greenhouse which they have constructed in the background, for practical instruction in horticulture and botany. The gate stands open all day and callers may wander at will but are requested to sign the visitors' book as they leave. Admission is free. Mr. J. B. KEIL, the instructor in charge of the garden, answers questions freely and is a source of reliable information regarding BURBANK productions. Incidentally, he is engaged in the laudable task of collecting as many of BURBANK's creations as can be found, planting them in the garden. Although it is eighteen years since the master gardener, horticulturist and plant-breeder passed away, hundreds of people from this and other countries continue to visit this BURBANK shrine.

While BURBANK led a frugal life he was not stingy. He occasionally indulged in a rampage of buying useless clothing and gewgaws — probably a throw-back to the time when he desired such things and could not afford them — but such sprees never ran into very much money. Habits of thrift had been taught him as one of the cardinal virtues. Fundamentally he deplored waste. He believed in, and practiced, low cost production and he liked as well as the next one to drive a good bargain when he had something to sell, partly as a matter of pride in merchandizing and partly because he persuaded himself that all of his products were of superior merit.

On the other hand he was liberal with his donations to all sorts of worthy causes. Some twenty years before his death when he began to take in real money he quietly invested it in fertile valley land. He never speculated in mines and oil wells. Although, apparently, he did not invest in the stock offerings of the two promotion schemes that bore his name, he did lose considerable money both directly and indirectly because of his dealings with them.

While on occasion he talked hard times and complained loudly of the injustice of having to run a private experiment station for the benefit of the public, and the unfairness of patent and trade-mark laws that did not protect him from those who bootlegged his products, I firmly believe that it was not money that he craved but *recognition.* Toward the end of his life — the last ten years — there seemed to be some influence that caused him to go out for the money. It was during this period that he quit raising and selling trees, practically ceased his breeding activities, and gave his whole attention to the seed business. He has told us that he did this because there was more profit in selling seeds than in selling trees. And he was making money fast when he died. Twenty years earlier money was decidedly a secondary consideration to the breeding of plants useful to man.

When BURBANK died he owned several farms and fruit ranches, most of the latter not yet in bearing. The Sebastopol tract was good property because of the large collection of hybrid trees and other things. The gardens in Santa Rosa, approximately seven acres — once in the country but now in the interior of a city of 12,000 people — represented a high value, and doubtless he was possessed of other things of value such as intangibles. At any rate his total estate was appraised at a figure in excess of $168,000. This represented an average net saving — a term dear to the New Englander of his day — of over $3,300 for each of the fifty years of his life after coming to California. Not a bad monetary showing for a man who started with nothing and followed his bent even though it led him into strange and unexplored fields. How many of us who blithely criticise can truthfully say that we have done as well?

## XXI

## THE BURBANK FAMILY

LUTHER BURBANK, son of SAMUEL W. and OLIVE ROSS BURBANK, was born in the village of Lancaster, Massachusetts, March 7, 1849, and died in Santa Rosa, California, April 11, 1926, at the age of 77. He was married to HELEN COLEMAN in Denver, Colorado, September 23, 1890, and divorced her October 19, 1896. On December 21, 1916, he was married in San Francisco to ELIZABETH WATERS, who survives him. He had no children.

In his autobiography[127] LUTHER tells us that his father was married three times — that his mother was the last of the three wives and that he was a thirteenth child; also that he had a younger brother and sister. So there must have been fifteen children in all — an example in mass breeding that he facetiously refers to as having been emulated in his generation with plants rather than with humans. Apparently — as will be seen later — all of the children were borne to the first and third wives, although this point cannot be verified. Two died in infancy, according to LUTHER's own statement, but whether their mother was BURBANK Senior's first or second wife is not clear. Somewhere I seem to have heard that the second wife did not live very long. The children may have been hers.

BURBANK, Senior, appears to have been a man of substance for his day and time. In addition to his farm he also operated a brick yard. Perhaps this accounts for the fact that he lived in a substantial two-story brick house, a more imposing structure than Lancaster Academy (a one-story brick building) where LUTHER received a part of his education.

SAMUEL BURBANK died in 1868. In 1871 the widow moved to Groton — now Ayer — a few miles away in the same county. The family had now dwindled to three children — LUTHER, brother ALFRED and sister EMMA, the others having established homes of their own. Later, LUTHER tells us, he purchased a small tract of land in the nearby village of Lunenburg and started a market garden. He loved plants and probably did a good job growing and selling vegetables but he early developed a greater interest in experimenting than in marketing. His curiosity led him to plant the seeds from a pod that he had noticed ripening on a potato plant. He was particularly intrigued because in his experience he had rarely ever before seen this variety — the Early Rose — in bloom.

[127] LUTHER BURBANK, his methods and discoveries and their practical application, 12: 7-8.

The seeds not only grew but one of them produced a cluster of white-skinned tubers of surpassing beauty of shape and form.

This was like drawing the grand prize in the Irish sweepstakes — a chance in a million. He tried the same gamble again and again throughout his life but never produced another potato of much value. The successful potato was sold to JAMES J. H. GREGORY of Marblehead, Massachusetts, an acquaintance of the family, as he had taught school in Lunenburg about the time the BURBANKS settled near there. GREGORY was not a seedsman but had been literally impressed into the business by his friends, and friends of his friends, all of whom wanted seeds of a superior, but hitherto unknown type of squash, which he had chanced to find growing in a New England kitchen garden. He paid LUTHER $150 for his potato and named it the Burbank. Now after seventy years it is still widely planted. With some extra money in hand LUTHER cut loose from the gardening business and left for California in the fall of 1875.

When in Lunenburg in the summer of 1937 I discovered among the records of the Town Hall a yellowing manuscript entitled "A history of the town of Lunenburg in Massachusetts from the original grant December 7, 1719, to January 1, 1866" by GEORGE A. CUNNINGHAM. Some unknown person had carried the chronicle forward for an additional eight years. Anent the BURBANK family I was privileged to copy the following:

"SAMUEL W. BURBANK, of Lancaster, married in Townsend, 10 October, 1821, HANNAH BALL, born in Townsend 31 October, 1800, a sister of VARNUM BALL (born in Townsend June 30, 1807). They never lived here, but the family is so connected with others here, that I insert it. She died in Lancaster, 17 February, 1840, aged 39 years, 3 months and 17 days. Eight children. He married (2nd) OLIVE ROSS,[128] born in Sterling, 1813, daughter of PETER and POLLY (BURPEE) ROSS. She came to this town with her children in 1871, after his death in Lancaster, 12 December 1868, aged 73 years, and lived in a house near the Methodist Church.

"Children born in Lancaster:

"1. SUSAN E., born 2 September, 1822, died 20 July, 1825, aged 3 years.

"2. SARAH M., born 21 February, 1826, married November, 1846, A. F. KIDDER of Lancaster, where they both died, leaving two children. 1. MARCIA L. and 2, LIZZIE.

"3. HANNAH E., born 5 April, 1828, died 23 March, 1843, aged 15 years.

"4. GEORGE W., born 17 November, 1829, married APPHIE R. BLAKE. Settled in California.

"5. LUCY A., born April, 1831, died 29 May, 1848, aged 17 years, 1 month and 25 days.

"6. HOSEA HERBERT, born 13 October, 1834, married 7 November, 1860, LIZZIE H. ANDERSON, born in Grafton, 1833. Lived in Westfield; one son, HENRY.

[128] OLIVE ROSS was SAMUEL BURBANK's third wife. Historian CUNNINGHAM, or his successor, may not have been well acquainted in Lancaster, which was ten miles away—a considerable distance in those days—or was he ignoring her intentionally as historians have done LUTHER's first wife? He also fails to mention that OLIVE's first two children died in infancy.

"7. ELIZA JENNY, born 17 April, 1836, married GEORGE VARNUM BALL.

"8. DAVID B., born 6 August, 1838, married 20 August, 1864, PAULINA V. BALL, born 17 August, 1838, daughter of Rev. HOSEA and SARAH (HELMES) BALL. They are—1874—living in California.

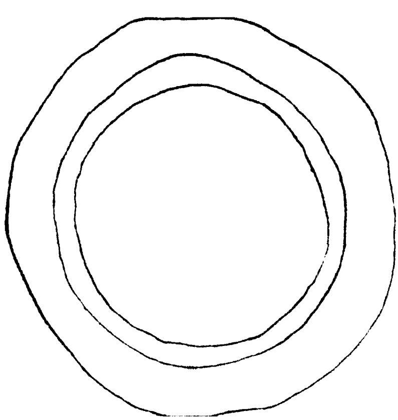
"By second [?] wife OLIVE:

"9. LUTHER, born 7 March, 1849.

"10. ALFRED WALTON, born 2 February, 1852.

"11. EMMA LOUISA, born 20 July, 1854."

While some of the Burbank blood was left in Massachusetts, most of the seed was transplanted to California, where presumably much still remains, but LUTHER himself, although twice married, did not leave a son or a daughter to carry forward either the germ plasm or the name, which to him must have been a secret disappointment. However, this is mere speculation as there is no record of his having expressed himself upon the subject.



VAN DEMAN QUINCE.— From LUTHER BURBANK'S "New Creations . . . ", p. 11 (1893).

# BIBLIOGRAPHY

Unfortunately BURBANK published very little unaided writing about the scientific aspects of his work, especially his philosophy of plant breeding. He was a busy man and preferred to let others speak for him. In 1902 he sent a paper entitled, *The Fundamental Principles of Plant Breeding,* to be read at the International Plant Breeding Conference in New York, which afterwards was published in pamphlet form. *The Training of the Human Plant,* by BURBANK, a pamphlet published by the Century Company in 1907 was well received by the press and pulpit.

*New Creations in Plant Life, an Authoritative Account of the Life and Work of Luther Burbank,* by W. S. HARWOOD, published by the Macmillan Company of New York, is perhaps the most widely known biography of BURBANK because it has been, and still is, used as a reference book in the public schools. It is highly colored and misleading in its implications. FREDERICK WILLIAM CLAMPETT, in his book, *Luther Burbank, Our Beloved Infidel,* published by the Macmillan Company in 1926, undertook to defend BURBANK's religious views.

BURBANK's scientific attainments were best set forth by the following: *Some Experiments of Luther Burbank,* by DAVID STARR JORDAN, in Popular Science Monthly, January, 1905; *Scientific Aspects of Luther Burbank's Work,* by DAVID STARR JORDAN and VERNON KELLOGG, published in book form by A. M. Robertson of San Francisco, in 1909; *A Visit to Luther Burbank,* by HUGO DE VRIES, in Popular Science Monthly, Vol. 67, pp. 329-347, 1907; and by the same author in his *Plant Breeding — Comments on the Experiments of Nilsson and Burbank,* published by the Open Court Publishing Company in 1907. Of these three authors, the writings of DE VRIES are to be preferred.

The monumental 12 volume work entitled, *Luther Burbank, His Methods and Discoveries and their Practical Application,* was dictated by BURBANK but was edited chiefly by HENRY SMITH WILLIAMS, who faithfully recorded much that was said but at times went farther and interpolated words and thoughts of his own which were unfair to the speaker. Published by the discredited, so-called Luther Burbank Society, the volumes represented the highest form of the printer's art of the time (1914) — deckle edges, ornate binding, hundreds of illustrations in colors — constituted a sizable library of popular reading matter covering the more dramatic episodes of BURBANK's childhood and professional life. *How Plants are Trained to Work for Man,* an 8 volume work, published by F. P. Collier in 1921, was much the same but condensed into fewer books.

*Harvest of the Years*, by LUTHER BURBANK with WILBUR HALL, published by Houghton Mifflin Company, 1926, is the most entertaining, and at the same time the most informative, BURBANK biography that has, as yet, been put out (a German edition has been published of this!). *Partner of Nature*, edited and transcribed by WILBUR HALL, published by the D. Appleton Company, 1939, gives us no new material. Other and less important references are to be found in the footnotes of the text.

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The title page and other front matter (p. i-vi) of Vol. 9 (1945) will be found bound at the beginning of the first number of the volume.

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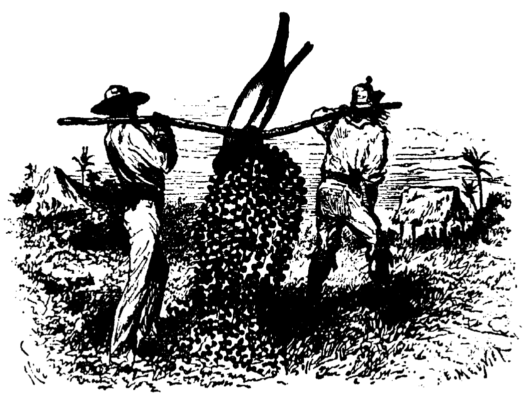

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**► A complete list, alphabetical by authors (or editors), of all Chronica Botanica Co. publications, including those which are in press and the few which are out of print.** — Nearly all these publications (as clearly indicated) belong to one of our three monograph series, CHRONICA BOTANICA, 'A NEW SERIES OF PLANT SCIENCE BOOKS', and ANNALES CRYPTOGAMICI ET PHYTOPATHOLOGICI. For check lists of volumes of the latter two series by numbers see p. ii. For information and terms of subscription to CHRONICA BOTANICA *see* p. xii (back cover).

► GOETHE'S BOTANY *by* **Agnes Arber**, D. Sc., author of 'Herbals' (Cambridge). — A modern, carefully prepared translation of JOHANN WOLFGANG VON GOETHE's 'Versuch die Metamorphose der Pflanzen zu erklären' (1790). Many critical notes. A special appendix deals with the fragment known as 'Die Natur', and attributed to GOETHE. — *Chronica Botanica, Vol. 10, No. 6;* Sup. roy. oct., ca. 80 pp., illustrated, *in press, ready autumn 1946*............**$2.50**

*Contents:* Introduction. A note on translations. Title page of the first issue of the first edition. Translation. Appendix: The fragment "Die Natur" (prefatory notes and translation).

►**FOREST TREE SEED OF THE NORTH TEMPERATE REGIONS** *by* **H. I. Baldwin**, Ph. D. (N. Hampshire Forestry Dept.). — The first modern book dealing exclusively with tree seed in English. With a polyglot glossary of tree seed terms. — *A New Series of Pl. Sci. Books, Vol. 8 (1942)*; Sup. roy. oct., buckram, 240 pp., 28 illustr..........**$4.75**

*Contents:* Structure and development. Seed production. The importance of seed source or provenance. Seed collection. Extraction. Cleaning and treatment. Storage and longevity. Insects, diseases and other enemies. Germination. Internal and external factors affecting germination. Chemical aspects. Seed stimulation. Different kinds of tests. Purity analysis. Determination of origin. Testing viability without germination. Testing of germination. Seed testing stations and certification. Research. Glossary. Indices.

The material presented is critically examined, well documented, and there are fairly extensive lists of references to literature. Much of the discussion on harvesting, storage, and germination pertains with equal validity to many types of plants, so that the book has a wide field of interest and usefulness beyond the more immediate limits of species of trees (KRAUS *in* BOT. GAZETTE).

The work will be indispensable to research workers in the field of tree seed and very useful to practical foresters and members of the seed trade. It is not a handbook of tree seed, giving cut and dried information about individual species, but a reference book and a guide, not only to existing knowledge but also to the directions in which that knowledge should be extended in the future (THOMSON *in* NATURE).

► **PLANT VIRUSES AND VIRUS DISEASES** *by* **F. C. Bawden**, Ph. D. (Rothamsted Experimental Station). — *Second entirely revised and modernized edition* with many new illustrations. No chapter remains unchanged, and more than half have been completely rewritten. Recent advances in all branches of the subject are described and correlated. Techniques new to botanists are discussed, special attention being given to work on the chemical, physico-chemical and serological properties of purified virus preparations. Modern concepts on the nature, origin, size and multiplication of viruses are critically reviewed. — *A New Series of Pl. Sci. Bks., Vol. 13 (1943)*; Sup. roy. oct., buckram, 294 pp., 48 illustr...........**$4.75**

*Contents:* Symptomatology. Transmission. Relationships between viruses and insect vectors. Virus strains, mutation, and acquired immunity. Serological reactions. Methods of purification. Properties of purified virus preparations. Optical properties of purified virus preparations. Inactivation of viruses. The sizes of virus particles. Physiology of virus-diseased plants. The classification of viruses. Control. Origin and multiplication of viruses.

In recent years students of plant viruses have been joined by workers in subjects which at first sight seem to have little connection with plant pathology. Biochemists, physical chemists, serologists, statisticians and X-ray specialists have all taken a hand in the game and the ordinary biologist finds himself somewhat bewildered by these specialists each talking a jargon of his own. One welcomes therefore the present volume which gives a lucid explanation of much of this unfamiliar technique . . . written in an interesting and readable style and the subject is presented in a coherent and consecutive manner and is not a mere statement of unrelated facts (K. M. SMITH *in* J. PATH. BACT.).

While it is true that the subject-matter is weighted to the plant viruses the fundamental principles of transmission, mutation, immunity, serological reactions, methods of purification, properties, together with the data on inactivitation and size of virus particles here given can well be guides to extension of exploration into similar agents affecting animal tissue and growth. And the discussion on origin and multiplication of viruses should make all biologists furiously to think (HAMMETT *in* GROWTH).

► **A SOURCE BOOK OF AGRICULTURAL CHEMISTRY** *by* **C. A. Browne**, Ph. D., Sc. D. (U. S. Dept. of Agriculture). — A History of Developments in the Application of Chemistry to the Theory and Practice of Agriculture from the Time of DEMOCRITUS to the Period of LIEBIG. — *Chronica Botanica, Vol. 8, No. 1 (1944)*; Sup. roy. oct., 290 pp., 1 plate, 32 illustr....................................**$5.00**

*Contents:* Agricultural chemistry in ancient times. Agricultural chemistry in the alchemical and iatrochemical periods. Agricultural chemistry in the time of the early Royal Society. Agricultural chemistry in the early phlogiston period. Agricultural chemistry in the late phlogiston period. Agricultural chemistry during the chemical revolution. Agricultural chemistry at the beginning of the modern period.

This is one of the rare books the extraordinary scope and meaning of which have not been and apparently could not be covered adequately by title. It is far more than "A Source Book of Agricultural Chemistry." It is a documentary history of the change of chemical concepts within agriculture, and it touches in its travel from Graeco-Roman antiquity to the period initiated by JUSTUS VON LIEBIG, an almost incredible variety of subjects and ideas. Beneath the chapters forming this book and the judgments contained in it, lies an enormous amount of searching, reading, reflection and discernment. The method employed by CHARLES A. BROWNE is a bio-bibliographical one. Brief but pertinent biographies of the authors quoted are followed by extracts from their writings, and both authors and quotations are presented in relation to the world in which they lived and to posterity, offering much essential information for every one interested in the development of science and of human thought (URDANG *in* J. AM. PHARM. ASSOC.).

Perhaps few general histories of science come sufficiently close to historical grassroots to actually be in a position of demonstrating the true educational and intellectual value of science history. The volume under review accomplishes precisely that to a degree seldom equalled (GRAUBARD *in* THE SCI. MONTHLY).

► **THOMAS JEFFERSON AND THE SCIENTIFIC TRENDS OF HIS TIME** *by* **C. A. Browne**, Ph. D., Sc. D. (U. S. Dept. of Agriculture). — A scholarly essay, by the Nestor of American Agricultural Chemists, on THOMAS JEFFERSON's position in the world of science, his "Notes on the State of Virginia", his scientific services to the new republic of the United States, his agricultural and educational work, and some of the eminent contemporaries who knew JEFFERSON personally and exchanged with him

letters that throw much light on the scientific movements of the time. — *Chronica Botanica, Vol. 8, No. 3 (1944)*; Sup. roy. oct., 64 pp., illustrated with 17 contemporary drawings, maps, and facsimiles......**$1.25**

This volume is one of the finest tributes to THOMAS JEFFERSON which has recently been published to commemorate the 200th anniversary of his birth. It is handsomely illustrated with maps, facsimiles, a wood cut of Monticello, an old wood engraving of the University of Virginia, a diagram of the Monticello Garden, a silhouette of JEFFERSON, a drawing of the plant *Jeffersonia* Barton, and other cuts . . . This timely, scholarly, carefully documented, and beautifully written account of the labors of JEFFERSON and his contemporaries is a valuable contribution to the history of science in America (WEEKS *in* J. OF CHEM. EDUC.).

► **THE CEREAL RUSTS AS EXEMPLIFIED BY THE LEAF RUST OF WHEAT** *by* **K. Starr Chester**, Ph.D. (Oklahoma Agricultural and Mech. College). — Wheat is the world's foremost crop and rust its most formidable adversary. The book provides a pattern of the principal features of cereal rust behavior and control based on a comprehensive account of the most widespread and in many cases the most destructive of the cereal rusts, the leaf rust of wheat, which has not hitherto been the subject of monographic treatment. The exposition, which has an international point of view, is based on the world literature, particularly the Russian, and on the author's researches in the field. Especial emphasis is given to environmental relationships and epiphytology of the rust. — *Ann. Crypt. et Phytop., Vol. 4;* Sup. roy. oct., buckram, ca. 250 pp., illustrated, *in press, ready summer 1946*....................... *ca.* **$5.00**

*Contents:* Introduction; names and history of the disease. Origin, distribution, and economic importance. Effect of the rust on the host plant and its yields. Suscepts. Symptomatology. Etiology. Physiologic specialization. Factors affecting rust survival and development. Rust dissemination; annual cycles; epiphytotics. Natural, regulatory, and cultural rust control. Rust control by the use of fungicides. Control by rust resistance.

► **ARBORETUMS, THEIR AIMS AND SCOPE** *by* **Gordon D. Cooper**, B.S.A., Fellow, Am. Soc. of Landscape Architects (Cleveland, O.). — The author, who has gone to great efforts to study the organization and growth of arboretums in the U.S.A., presents a detailed analysis of all possible problems connected with the establishment and development of an arboretum, with special reference to North American conditions. There are two interesting supplements: (1) a historical account of arboretums, on an international basis, by L. H. BAAS BECKING, and (2) an annotated list of the principal arboretums of North America. — *Chronica Botanica, Vol. 11, No. 3;* Sup. roy. oct., ca. 100 pp., illustrated, *in press, ready spring 1947* ........................................**$3.00**

*Contents:* Botanical institutions. Purposes of arboretums. Need for arboretums. History of arboretums. Functions of arboretums. Requirements for a modern arboretum. Selection of sites for arboretums. Contents of arboretums. General design of arboretums. Special design. Steps in the making of an arboretum. Supplements (*cf. supra*).

► **GENERA FILICUM — THE GENERA OF FERNS** *by* **Edwin Bingham Copeland**, Ph. D. (Univ. of California). — An account of the genera and families of pteridophytes filling the long-felt need for a modern account of the ferns and fern allies of the world. — *Ann. Crypt. et Phytop., Vol. 5;* Sup. roy. oct., buckram, ca. 300 pp., 10 plates, *in press, ready autumn 1946*................................**$6.00**

*From the foreword:* The first reason for the preparation and publication of this book is the fact that progress in our understanding of systematic pteridology during the past half-century has been so great that no existing general work on the subject retains much more than a historical value. — The second is that it beseems the author of a large number of papers dealing with details and with parts of a general subject to digest and summarize his work, and to present it properly integrated with that of his predecessors and contemporaries . . . This may be something of wider significance than a treatise on the genera of ferns. It is the author's belief that pteridology has returned to its position of a century ago, as the best developed field of systematic botany; that it is possible to demonstrate the phylogeny of fern genera more clearly and convincingly than that of any other similarly great group of plants can be presented.

► **PEAT — THE FORMATION, COMPOSITION, PROPERTIES AND UTILIZATION OF THE PEATS OF THE WORLD,** *by* **A. P. Dachnowski Stokes**, Ph.D. (U.S. Dept. of Agriculture). — The author's own research and experience of many years give him the background necessary to a better understanding of peat deposits throughout the world, their materials, and the factors affecting their utilization. The book summarizes basic information and shows how the progress in peat investigations has led to specialization of research in various lines of scientific study. The more important results so far achieved by government agencies, experiment stations, universities, and other research institutions are discussed, together with their wide implication to agriculture, industry, and technology. — *A New Series of Pl. Sci. Bks., Vol. 20;* Roy. oct., buckram, ca. 220 pp., illustrated, *in press*............ *ca.* **$4.50**

*Contents:* Introduction. Main groups and types of peat, their botanical composition and uses. Physical properties of different kinds of peat. Chemical composition of various peat materials. Thermochemistry of peats. Microbiological activity in the formation and decomposition of peat materials. Biochemical activity in peat composts. Formation and stratification of peat deposits. Factors in the classification of peat deposits. Geographical distribution of peat deposits. Correlations. Bibliography.

► **PRINCIPLES OF PALEOBOTANY** *by* **William C. Darrah** (Harvard U.).—*A New Series of Pl. Sci. Bks., Vol. 3 (1939)*; Roy. oct., 239 pp., 7 pl.; ***out of print***, a new edition is in preparation.

► **AN INTRODUCTION TO POLLEN ANALYSIS** *by* **G. Erdtman**, Fil. Dr. (Västerås, Sweden). *Foreword by* **Roger P. Wodehouse**, author of 'Pollen Grains'. — The first and only comprehensive reference work on the methodology and applications of pollen analysis. — *A New Series of Pl. Sci. Bks., Vol. 12 (1943)*; Sup. roy. oct., buckram, 239 pp., 46 plates and illustr. ....................................**$5.00**

*From the contents:* Historical. Chemistry of Peat. Pollen Preparations. Preparation of Fossil Pollen-Bearing Material. Pollen and Spore Morphology. Graphic Presentation. Correlation. Output and Dissemination of Pollen. Surface Samples. Pollen Flora of Peat Samples. Investigations in different Countries. Tertiary Deposits. Honey and Drugs.

It was G. ERDTMAN, a Swede, who in the nineteen-twenties introduced British and American scientific men to the principles and technique of pollen analysis, a new method of geological inquiry which had recently been developed in Scandinavia, particularly by the energy and insight of L. VON POST. The succeeding years have seen a very great extension of the applications of pollen analysis. Not only has it been used in countries in all parts of the world to elucidate their forest history, and thence the drift of former climatic conditions, but also it has been shown to afford the means of solving an unexpectedly wide range of problems . . . It has long been recognized that dating of prehistoric objects and structures found in lake or bog deposits is often possible by reference to the geochronological scale afforded by the regular drift of forest history. Similarly, the course of relative movement of land- and sea-level may be effectively dated, and eustatic effects distinguished from isostatic. More recently, it has become apparent that not only is the former distribution of natural plant communities reflected by pollen analyses, so that the conditions of salt-marsh, lake, fen, forest and bog may be accurately recognized in buried layers, but also, as IVERSON has shown, the influence of prehistoric man in modifying natural communities may be detected, together with the origin of the new anthropogenous vegetation he has created . . . Hitherto no text-book of pollen analysis has

been available, and we warmly welcome, therefore, the appearance of the "Introduction to Pollen Analysis" by Dr. ERDTMAN. He has himself in the last twenty years contributed important results to the field of pollen analysis. He has developed a technique of preparation by chlorination and acid-hydrolysis which very greatly simplifies counting of grains in materials poor in pollen: he has sharpened the technique of critical recognition of species by their pollen morphology, and he has contributed much to the knowledge of long-distance flight of pollen. In this book these matters are given adequate treatment, together with such related topics as the analysis of pollen in honey as a basis for determination of the country and season of its origin, and the geological use of spore-counts in coal seams (GOODWIN *in* NATURE).

► THE GENUS BAZZANIA IN CENTRAL AND SOUTH AMERICA *by* **Margaret Fulford**, Ph.D. (Univ. of Cincinnati). — A critical monograph of one of the most interesting genera of liverworts, the first complete modern revision of the neotropical species of a large and difficult genus of hepaticae, since STEPHANI produced his confusing *Species Hepaticarum.* — *Ann. Crypt. et Phytop., Vol. 3;* Sup. roy. oct., ca. 176 pp., 59 plates, *in press, ready shortly*.......**$5.00**

► ROOT DISEASE FUNGI *by* **S. D. Garrett**, M.A., D.I. (Rothamsted Experimental Station). — The first book dealing exclusively with this important group of fungi. Principles of root disease control are fully expounded for the benefit of all practising plant pathologists. Control measures are classified separately for field, plantation and glasshouse crops. A special feature is the full treatment of root disease control in tropical and subtropical crops, but no important root disease of any crop has been omitted. Of particular interest to soil microbiologists are the chapters on biology and evolution of the root-infecting fungi. — *Ann. Crypt. et Phyt., Vol. 1 (1944)*; Roy. oct., buckram, 177 pp., 9 illustr...**$4.50**

*Contents:* Parasitic specialisation in the root-infecting fungi. Parasitic activity of the root-infecting fungi. Influence of soil temperature upon parasitic activity. Influence of soil moisture content, texture, and reaction upon parasitic activity. Influence of soil organic content and concentration of plant nutrients upon parasitic activity. Saprophytic activity of the root-infecting fungi. Dormancy of the root-infecting fungi. Control of root disease in field crops: crop rotation. Control of root disease in field crops: plant sanitation. Control of root disease in field crops: disease control under the growing crop. Control of root disease in plantation crops: on virgin areas. Control of root disease in plantation crops: in mature plantations and on replanted areas. Control of root disease in plantation crops: special problems. Control of root disease in glasshouse crops. Bibliography.

The appearance of this book marks the first volume of Annales Cryptogamici et Phytopathologici, edited by FRANS VERDOORN. The author stresses the relationships between the inciting agents of these diseases and their habitats—the soil. The book is an interesting ecological study of an important group of causal agents within the larger field of root diseases of plants . . . It is well written and the illustrations are excellent (LINK *in* THE BOT. GAZETTE).

This book is of more than usual interest to those having to do with soil management in relation to crop production in that it deals with one of the more obscure phases of this problem about which there is great need for more exact information than has been contained in the usual classroom text-book (SOIL SCIENCE).

*A copy of Garrett's Root Disease Fungi was included in the highly selective exhibit, organized in San Francisco at the occasion of the United Nations Conference, of 120 technically outstanding books, recently produced in the U. S. A.*

► **WOOD PULP** *by* **Julius Grant**, Author of 'Books and Documents', etc.—*A New Series of Pl. Sci. Bks., Vol. 2 (1938)*; Roy. oct., 209 pp.; *out of print*.—It is planned to deal again with the subject matter of this book in a forthcoming volume on wood chemistry and related subjects.

► THE CYTOPLASM OF THE PLANT CELL *by* Dr. **Alexandre Guilliermond** (Sorbonne), *authorized translation from the unpublished manuscript by* **Lenette Rogers Atkinson.** *Foreword by* **William Seifriz.** — A critical review of our present knowledge of the cytoplasm and its morphological constituents by the eminent French cytologist. — *A New Series of Pl. Sci. Bks., Vol. 6 (1941)*; Sup. roy. oct., buckram, 247 pp., 152 illustr...........................**$4.75**

*Contents:* General facts on the structure of the plant cell, its cytoplasm and morphological constituents. The physical properties and general characteristics of the cytoplasm. Chemical constituents. Physico-chemical constituents of the cytoplasm. The plastids. The chondriome. The relationship between chondriosomes and plastids. Duality of the chondriome. Hypotheses relative to the role of chondriosomes and plastids. The vacuoles. Vital staining of the vacuoles. Development of the vacuolar system. Origin and significance of the vacuoles. The role of the vacuolar system and hypotheses concerning it. Golgi apparatus, canaliculi of Holmgren and other cytoplasmic formations. Lipide granules, microsomes and other metabolic products. Cytoplasmic alterations.

The present volume is the first addition, printed in America, to the list of books which Dr. FRANS VERDOORN is editing and publishing under the title, A New Series of Plant Science Books. Mrs. ATKINSON has accomplished an excellent job of translating and interpreting for English readers a highly stimulating work, which can be recommended to botanists generally (BEAL *in* BOT. GAZETTE).

This book gives a thorough, critical and well-balanced survey of the various theories on cytoplasm, chondriosomes, plastids, vacuoles, etc., in which both the morphological and the functional (physico-chemical) point of view have been adequately stressed. Though the author, as one of the leading cytologists, has his own pronounced views, he always does justice to contrary views, so that a very high degree of objectivity in the treatment is obtained (LÜTJEHARMS *in* J. S. AF. BOT.).

► LECTURES ON THE INORGANIC NUTRITION OF PLANTS *by* **D. R. Hoagland**, A.M. (Univ. of California). — This series of lectures, based on the *Prather Lectures at Harvard University,* delivered by the author in the spring of 1942, outlines a number of important problems of plant nutrition, with a very considerable amount of illustrative material derived from extensive researches at the Univ. of California. Scientific aspects of certain soil-plant interrelations, nutrient absorption and utilization, and artificial culture methods are primarily discussed. Trends of research in plant nutrition and opportunities for further exploration are stressed. — *A New Series of Pl. Sci. Bks., Vol. 14 (1944)*; Roy. oct., buckram, 226 pp., numerous ill., tables and plates............**$4.00**

*Contents:* A survey of problems. Micronutrient chemical elements and plant growth. The absorption and accumulation of salts. Upward movement and distribution of inorganic solutes. The growth of plants in artificial media. Some biochemical problems associated with salt absorption. Aspects of the potassium nutrition of plants as illustrating problems of the system, soil-plant-atmosphere.

The discussions are based upon work done in many laboratories, but with emphasis upon work done in the Div. of Plant Nutrition of the Univ. of California, where Dr. HOAGLAND'S genius has found its expression in a long series of distinguished contributions. He and his coworkers have been leaders in this field for many years, and it is a valuable service to plant physiologists to have the field presented by one so familiar with the techniques and the historical development of the subject of inorganic nutrition of plants. It is excellent in bringing the various phases of nutrition into a true perspective, and giving in compact space the essential ideas and philosophy of this region of plant physiology.—It is so well done that it is hoped that every member of *the American Society of Plant Physiology* will want a personal copy of it (PLANT PHYSIOLOGY).

Aunque el Prof. HOAGLAND, primera autoridad sobre estos estudios en el Continente americano, no considera esta compilación de conferencias, ni como monografía ni como libro de texto, estimamos que es la mejor exposición actual, en lengua inglesa, sobre nutrición mineral de los vegetales, principalmente de los superiores, libro indispensable para el fisiólogo y también para el agrónomo que se interese por la fertilización de los suelos y el alimento de las plantas de cultivo (M. CASTAÑEDA *in* CIENCIA).

► SCIENCE AND SCIENTISTS IN THE NETHERLANDS INDIES *edited by* **Pieter Honig**, Ph. D. and **Frans Verdoorn**, Ph. D. — A review of research

and exploration in the Neth. Indies. Prepared under the auspices of the Board for the Netherlands Indies, Surinam and Curaçao. — *Natuurwet. Tijdschrift voor Ned.-Indië, Vol. 102, Special Supplement (1945)*; Sup. roy. oct., cloth, xxiv + 491 double column pp., 134 pl. and text illustr............$4.00

*From the contents:* *Bakker:* On livestock and the veterinary service; *van Bemmelen:* Mineral resources and their industrial possibilities; *Bernard:* Le Jardin Botanique de Buitenzorg; *Braak:* The climate and meteorological research; ter *Braake:* Volcanology in the Netherlands Indies; *Brest van Kempen:* Earthquakes in the Netherlands Indies; *Broek:* Diversity and unity in Southeast Asia; *Coombs:* The International Rubber Regulation Committee; *Coster:* The West Java Research Institute; *Dammerman:* A history of the Treub laboratory; *Donath & van Veen:* A short history of beri-beri investigations; *Fairchild:* Buitenzorg and Doctor Treub (1896); *Fairchild:* Rambles in Deli (1926); *Fairchild:* Gardens of the East from the air (1940); *Field:* Felix Alexander Vening Meinesz; *Forbes:* Through Bantam and the Preanger Regencies; *Frickers, Haasjes & Hoskins:* On veterinary science; *Groot:* Missionary physicians and hospitals; *von Heine-Geldern:* Prehistoric research in the Netherlands Indies; *Herre:* Fish research in the Indo-Australian archipelago; *Honig:* Agriculture in the Netherlands Indies; *Honig:* Cinchona—introductory review; *van Gorkom:* Introduction of cinchona into Java; *van Leersum:* Junghuhn and cinchona cultivation; *van Gorkom:* Cinchona cultivation after Junghuhn; *Taylor:* Modern developments in cinchona cultivation; *Koolhaas:* Half a century of phytochemical research; *Koolhaas:* Phytochemical researches by visitors; *van de Koppel:* Forestry in the outer provinces; *Kuiper:* Astronomy in the Netherlands Indies; *Lieftinck & van Bemmel:* The Buitenzorg Zoological Museum; *Massart:* Notes javanaises; *Mayr:* Wallace's line and recent zoogeography; *Mohr:* Climate and soil; *Mohr:* Soil and population density; *Moon:* On Pinus mercusi of N. Sumatra; *Myers:* Sediments in the Java Sea; *Otten-van Stockum:* Rabies research in the Neth. Indies; *Posthumus:* Paleobotanical research in the Neth. Indies; *Riemens:* The Hot Springs Conference; *Roelofsen:* The Deli Tobacco Experiment Station; *Schneider:* Eine Reise in Nord-Sumatra; *Sirks:* Rumphius, the Blind Seer of Amboina; *Snapper:* Medical contributions from the Neth. Indies; *Stauffer:* The geology of the Netherlands Indies; *van Steenis:* A trip to South Sumatra; *Tengwall:* Rubber cultivation and research; *Vlugter:* Hydrodynamic research in the Netherlands Indies; *de Waart:* Medical education in the Netherlands Indies; *Wallace:* Exploration in Celebes; *Weidenreich:* The puzzle of Pithecanthropus; *Went p. & f.:* General botany in the Neth. Indies; *Dammerman:* The fauna of Tjibodas; *Doctors van Leeuwen:* The flora of Tjibodas; *Dakkus:* The Botanical Garden at Tjibodas; *Westermann:* Wild life conservation in the Netherlands Empire.

The volume concludes with an extensive list of research institutions and research workers in science and technology in the Netherlands Indies at the time of the 1942 invasion, news items, bibliographical notes, a report of the Central Depository Library for the Netherlands Indies in New York City (established by VERDOORN in 1943), etc.

► **FUNGICIDES AND THEIR ACTION** *by* **J. G. Horsfall**, Ph.D. (Connecticut Agric. Experiment Station). — An examination of the physics and chemistry of the mechanisms by which fungicides control plant diseases. Pertinent data are reviewed and critically discussed in the light of a relatively new tool for assay; namely, dosage-response. An analysis is given of the problem of deposition, coverage and tenacity as factors in protection. A discussion is also given of the factors in artificial immunization and chemotherapy, synergism, and modes of toxic action, for copper and sulphur, fungicides. The book ends with two chapters on the new organic fungicides and phytotoxicity. — *Ann. Crypt. et Phyt., Vol. 2 (1945)*; Roy. oct., buckram, 239 pp., 19 illustr..........$5.00

*Contents:* Historical introduction. Some general concepts. Laboratory assay. Some problems of data assessment. Principles of chemical protection. Deposition. Coverage of single surfaces. Coverage of multiple surfaces. Tenacity. Artificial immunization and chemotherapy. Action of copper. Action of sulfur. Action of organic nitrogen compounds. Action of other organic compounds. Antagonism and synergism. Phytotoxicity.

► **LUTHER BURBANK, A VICTIM OF HERO WORSHIP** *by* **W. L. Howard**, Ph. D. (Univ. of California). — Some twelve years ago the writer undertook the preparation of an authentic list of all fruits, flowers, vegetables, and other things, the late LUTHER BURBANK introduced during the fifty years of his working life, and where possible, giving some idea of their worth. The task was prolonged because BURBANK kept no systematic record of what he produced. His advertising literature was scattered to the four winds. The author personally examined libraries and private collections from Coast to Coast. To determine the value of many of BURBANK's productions it was necessary to contact dealers all over the world. — A by-product of the studies was a mass of information, much of it new, about the man himself, which answered many puzzling questions. — *Chronica Botanica, Vol. 9, No. 5/6 (1945)*; Sup. roy. oct., 208 pp., illustrated by photographs and facsimiles.......$3.75

*Contents:* The background. The man. The nurseryman. The scientist. The egoist. The mentor of youth. The unfortunate. The pariah (of scientists). The disappointed. The world character. The individualist. Ethics. Religion. Foray into science—the Carnegie grant. Admirers. Detractors. BURBANK's place in the hall of fame. Summary of BURBANK's productions. Aftermath. The BURBANK family.

In 21 chapters the leading events of BURBANK's life are discussed objectively, but fairly, frankly and without embellishment. This is, without doubt, the first true and complete picture of this controversial character, which labored for 50 years to improve economic plants and which produced and sent out over 800 new varieties of fruits, flowers and vegetables, many of them of permanent value.

► **BIOLOGICAL FIELD STATIONS OF THE WORLD** *by* **Homer A. Jack**, Ph. D. — An extensive and critical study of the aims, scope and organization of the biological field stations of the world. A unique

► A few technical notes: — If we feel that there is some chance that we will break even we issue our publications bound in buckram, stamped with genuine gold (this is hardly ever used at present, not even by the university presses), with fine endpapers such as are only used in limited editions, etc. — When the number of advance orders is so small that we feel sure that a publication will be published at a positive deficit, it is our policy to issue it strongly bound in paper. This is the only 'sacrifice in quality' which we sometimes make. In all other aspects our publications, those which are commercially sound, as well as those which are published at a loss, are produced according to unusually high and internationally famous standards, printed on superior, durable paper. Though this is no longer usual in much commercial work we continue to print all personal names with SMALL CAPITALS, and Latin plant names with *italics*.

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*The Publishers' Weekly* discussing "Hayfever Plants", a typical, average volume of our "A New Series of Plant Science Books", declares: [This] "is an excellent example of how, with good typographical knowledge and great skill, a scholarly text embodying such difficult features as tables, figure columns, footnotes, glossary, and bibliography, can be made into a handsome almost elegant book. Verdoorn successfully solved many knotty problems in the design of this volume, and it is unfortunate that space will not allow a more detailed discussion of the points involved. The many line cuts of plants beautifully combined with the text have produced a perfectly balanced page. The type pages, though at times by necessity quite condensed, are always clean and readable. Chapter titles and section titles contrast well with the old style used for the text. Nothing has been left undone to increase the consultability of the material and yet no space has been wasted. The end paper in French blue nicely matches the dark blue buckram of the binding, the Bordeaux red top stain and head band add to the appearance of this handsome volume."

account of great practical, as well as historical interest. Based on the results of years of travel and world wide systematic enquiries. — *Chronica Botanica, Vol. 9, No. 1 (1945)*; Sup. roy. oct., 74 pp., illustrated ..................................$2.50

*From the contents:* Purpose of biological stations. History. Location. Administration. Equipment. Living Facilities. Instruction. Educational Philosophy. Research. Annotated list of biological stations covering the entire world, with much practical information, publications, references, etc.

► PLANT EMBRYOLOGY, AN INTRODUCTION TO THE EMBRYOLOGY OF THE FLOWERING PLANTS *by* Donald A. Johansen, Ph. D., author of 'Plant Microtechnique'. — This is the first book to be prepared that deals exclusively with embryology sensu stricto. The gymnospermous phyla are first discussed, following which the flowering plants are exhaustively considered. The laws of embryogeny are described in detail and illustrative examples are cited. These laws form the basis for a simple, logical classification of the various types of embryogeny prevalent among angiosperms. A systematic treatment of all species whose development has been sufficiently described in the literature is presented, with each species classified as accurately as possible. Apomictic embryogeny, adventitious embryogeny and polyembryony are considered in separate chapters and the various manifestations of each have also been classified. — *A New Series of Pl. Sci. Bks., Vol. 19;* Sup. roy. oct., buckram, ca. 300 pp., with numerous illustrations, *in press, ready shortly* ................................ *ca.* $6.00

*Contents:* Cycadophyta: Cycadaceae. Ginkgophyta: Ginkgoaceae. Coniferophyta: Pinaceae, Araucariaceae, Sciadopitaceae, Taxodiaceae. Cupressaceae, Saxegothaeaceae, Podocarpaceae, Pherosphaeraceae, Cephalotaxaceae, Taxaceae. Ephedrophyta: Ephedraceae, Gnetaceae, Welwitschiaceae. Anthophyta: General Considerations, Types and Variations, Special and Comparative Embryology, Apomictic Embryogeny, Adventitious Embryogeny, Polyembryony. Glossary, Indices.

► THE CARNIVOROUS PLANTS *by* F. E. Lloyd, D. Sc., Emeritus Prof. of Botany, McGill University.—Since the appearance of Charles Darwin's "Insectivorous Plants" in 1875 no comprehensive treatise on these biologically exceedingly interesting plants has appeared. The gradual advance of our knowledge has been summarized from time to time by Drude, Pfeffer, Ed. Morren, Hooker, Goebel and Lloyd, but a fully documented treatment was greatly needed. The illustrations are nearly all original and include numerous halftone plates, enabling the reader to visualize the forms discussed, and a large number of line drawings amplifying the text. — *A New Series of Pl. Sci. Bks., Vol. 9 (1942)*; Sup. roy. oct., buckram, 352 pp., several hundred illustrations ......................................$6.00

*Contents:* Introduction. Heliamphora. Sarracenia. Darlingtonia californica. Nepenthes. Cephalotus follicularis. Genlisea. Byblis. Drosophyllum lusitanicum. Pinguicula. Drosera. The carnivorous Fungi. Dionaea. Aldrovanda. Utricularia, Biovularia, and Polypompholyx. Indices.

It is so clearly and entertainingly written that anyone with a modicum of botanical knowledge can enjoy it and use it as a guide. Professor Lloyd's drawings and photographs are very clear and helpful, and the 38 plates incorporate hundreds of them. Production is of the high standard we have learnt to expect from Chronica Botanica. Altogether, a distinguished performance for which thanks and congratulations are due to both author and publisher (Stephens *in* J. So. Af. Bot.).

It is, therefore, the more commendable and welcome that finally Lloyd has completed this comprehensive authoritative, and detailed study of the carnivorous plants. Any such study which traces a function or an activity through the diverse plants possessing it is bound to have a significant influence on science, and this authoritative volume without doubt will prove to be an epoch-making one. Comprising in large part the author's own original work, yet with a masterly synthesis of all the pertinent work previously done by others, the book has a thoroughness and completeness that stamp it as outstanding. All possible aspects of the plants concerned—their taxonomy, anatomy, physiology, ecology, and relationship—are considered in detail, with authoritative knowledge derived from the writer's 13 years of enthusiastic devotion to this field, devotion that involved careful absorption of an extensive literature in several languages, and first hand study of living material on this continent, in Europe, and in more remote localities during two journeys—one to Africa, another to Africa and Australia—supplemented by extensive correspondence, by securing the cooperation of collectors and naturalists in favorable localities, and by periods of study at various botanic gardens and laboratories . . . The volume is a beautiful job of craftsmanship (Quart. Review of Biol.).

► TREE GROWTH *by* D. T. MacDougal (Carnegie Inst. of Washington).—*A New Series of Pl. Sci. Bks., Vol. 1 (1938)*; Roy. oct., 240 pp., 20 illustrations; *out of print*.—Some time in the future we hope to publish a revised ed. or to include a treatment of the essentials of tree growth in a book on tree physiology. A few copies may still become available when we can again get in touch with our continental agents.

► EXPERIMENTELLE CYTOLOGIE *von* Hans H. Pfeiffer (Bremen).—The first comprehensive review by an internationally known and appreciated authority.—*A New Series of Pl. Sci. Bks., Vol. 4 (1940)*; Roy. oct., 243 pp., 28 illustr.; *out of print*.—A few copies may again become available as soon as we will be able to get in touch with our agents in the Netherlands. A second revised and enlarged edition will be published some years after the war.

► A LIFE OF TRAVELS *by* C. S. Rafinesque (1836). — A complete and verbatim reprint of the extremely rare autobiography (1836) of this famous and eccentric naturalist. Fitzpatrick (1911) lists only 17 known copies in the libraries of the world. — *Chronica Botanica, Vol. 8, No. 2 (1944)*; Sup. roy. oct., 72 pp., 5 portraits......................$2.50


*Contents:* Life and Travels till the first departure for America. Travels in North America during three years. Ten years' residence and travels in Sicily. My shipwreck and travels till 1819. Seven years' residence and travels in Kentucky. Travels from 1825 to 1830, in Virginia, Ohio, New York, etc. Travels and researches 1831/33. The sources of the R. Delaware and Susquehana. Conclusion. Travels and researches in 1834 and 1835, sources of the Schuylkill, central Alleghanies of Pennsylvania, Savings Banks, etc.

Only during the last 60 years has it dawned upon Americans, that the strange man, who died poor and lonely in Philadelphia in 1840 after having lived for 27 years among them, was not the "inspired idiot" he had been thought of and treated accordingly, but one of the greatest glories of

early American science, especially in the field of botany, zoology and anthropology. It seems he was even a great innovator in business, in inventing the "coupon" system in commercial papers. In his own case at least RAFINESQUE'S hopeful statement, "But time renders justice to all at last" seems to come true. This reprint of RAFINESQUE'S autobiographical sketch, still the fundamental document for all biographical work on the man, is a most welcome expression of the steadily increasing interest in RAFINESQUE. In spite of displaying an overwhelming amount of travelling done and of interests developed by RAFINESQUE, this self-description is still rather an understatement of the actual truth. The same is true of the almost unbelievable amount of ill luck and bad treatment experienced by the "eccentric naturalist." This autobiography, in listing carefully the scientific contacts of RAFINESQUE, which are identified by Dr. F. W. PENNELL and the VERDOORNS in an excellent index, gives a lively picture of American science in the first half of the 19th century,—and of the state of things in Sicily between 1805 and 1815 where RAFINESQUE was confined during the blockade. As CONSTANTINE SAMUEL RAFINESQUE-SCHMALTZ was born in 1783 in Constantinople the son of a French merchant and Greek lady of German ancestry, and as he was educated in France and Italy, allusions to other countries than the United States and Sicily, the two countries he studied longest and most intensely, are not lacking (ACKERKNECHT *in* BULL. HIST. MED.).

► **A SHORT HISTORY OF THE PLANT SCIENCES** *by* **H. S. Reed**, Ph.D. (U. of California). — A readable account of the growth of the plant sciences from early times to the present. The first 'History of Botany' written by an American and published in the U.S.A. — *A New Series of Pl. Sci. Bks., Vol. 7 (1942)*; Sup. roy. oct., buckram, 323 pp., 37 illustr. ......................................**$5.00**

*Contents:* Introduction. Gardeners and herbalists of antiquity. The nascent period. The retrogressive period. The renascent period. The seventeenth century. The eighteenth century. Gardens and other things. Plant geography in the nineteenth century. Morphology. Cytology. The water economy of plants. The fixation of carbon. The assimilation of nitrogen. The fixation and metabolism of nitrogen. Plant nutrition. Mineral constitutents in metabolism. History of mycology. Plant pathology. Significant names in the history of botany.

REED'S "Short History" is more than a dry record of progress. Through the kind and appreciative eyes of one of America's best-liked botanists the kaleidoscopic change in scenes and actors on the stage of botanical progress becomes a vivid adventure. This book will be enjoyed not only by professional botanists but also by students and others . . . This book is thoroughly original, in scope and treatment as well as in illustrations. We do not find the traditional portraits of the paragons of science which often are of questionable authenticity and usually are entirely non-committal as to the character of the subject. Instead, original illustrations of significant experiments, laboratories or publications are depicted, with delightful originality. One of the special values of the book is the adequate, though not undue, stress laid on the contributions of American scientists. The reviewer was surprised to find how seldom he disagreed with the author, which can only be attributed to the care with which Dr. REED has considered each contribution and the sympathy with which he has treated each contributor. It is easier to criticize mistakes than to appreciate positive advances, which become incorporated in our general body of knowledge and which can be recognized as advances only after careful consideration (WENT *in* SCIENCE).

► **ESQUISSE DE MES VOYAGES AU BRÉSIL ET PARAGUAY, CONSIDÉRÉS PRINCIPALEMENT SOUS LE RAPPORT DE LA BOTANIQUE** *par* **Auguste de Saint-Hilaire**, *with a biographical sketch by* **Anna E. Jenkins**, Ph. D. — *Chronica Botanica, Vol. 10, No. 1;* Sup. roy. oct., ca. 70 pp., illustrated, *in press, ready shortly*.......**$2.00**

This extensive travel account, reprinted from SAINT-HILAIRE'S *Histoire des Plantes les plus remarquables du Brésil et du Paraguay*, is being reprinted primarily at the request of a number of S. American botanists. Though in the first place of interest to botanists (the author gives an accurate description of his route) it contains much of a general biological, geographical and historical interest.

► **PLANTS AND VITAMINS** *by* Dr. **W. H. Schopfer** (Univ. of Berne), *authorized translation from the author's unpublished French-Swiss manuscript by* **Norbert L. Noecker** (U. of Notre Dame). *Foreword by* **W. J. Robbins**. — A critical review of the vitamin problem, written from the viewpoint of general physiology, transecting the various fields of biology; microbiology, plant and animal physiology, biochemistry, morphology, cytology, genetics, medicine, plant pathology, horticulture, and agriculture. The practical applications of vitamin research are given special consideration. The theoretical aspects are also treated and should be of interest to students and teachers of general biology. — *A New Series of Pl. Sci. Bks., Vol. 11 (1943)*; Sup. roy. oct., buckram, 300 pp., 20 illustr. ......................................**$4.75**

*Contents:* The plant cell and its capacity for synthesis. The experimental study of growth factors and the selection of test plants. Classification, terminology, and definition of active substances. The principal vitamins synthesized by plants. Their action on plants synthesizing them. The biosynthesis of vitamins. Thiamin. Yeast and bios. Nicotinic acid, its amide, and other analogues. Staphylococcus aureus. Riboflavin, pyridoxine, and their analogues. The lactic bacteria. The nitrogen fixing bacteria. The hemophilic organisms and their group of growth factors. Individual factors: Ascorbic acid, cholesterol and vitamin D, pimelic acid, the SH-Group. The function of growth factors of vitamin nature. The vitamins as coenzymes. The vitamins in relation with other active substances. General consideration concerning the presence and the loss of the capacity for synthesis. Vitamins in nature. Their rôle in agronomy and horticulture. Vitamin cycles. Growth factors and sexuality. Symbiosis, parasitism, and vitamins. Microorganisms as biological test objects for vitamins.

It is that rare thing: a complete textbook. Apparently everything relevant has been included, and the matter is right up to date as far as it is possible for it to be. 'Plants and Vitamins' gives the conspectus of a new subject—the need of plants for vitamins (NICOL *in* SOILS AND FERTILIZERS).

Few studies in biochemistry have aroused such popular interest as the remarkable advances made in recent years concerning the dependence of animals on small doses of those substances, produced mainly by plants, which we call the vitamins. It is natural that the marked heterotrophy for these substances in man has stimulated interest largely in the vitamin aspects of animal nutrition; but it has always seemed anomalous that the importance of vitamins to the plant which makes them, realized only vaguely even by many botanists, has not had wider publication. This gap has now been filled in this remarkable book, and it is well that the first major review should come from the hands of an expert, and indeed one who may be said to be the founder of the modern science of plant vitaminology. His book is, as it must be, of the nature of a preliminary report on a subject now in the full tide of development; but it tells, in an orderly way, of all the important advances made in the ten years since SCHOPFER (1934) first showed the necessity for vitamins in the culture of *Phycomyces*, with sufficient bibliography to enable enthusiasts to find other sources of information. It is further very satisfactory that the author, though not hesitating to reproduce and discuss the structural formulae of the vitamins and to emphasize the vitally important, if purely chemical aspects of vitamin structure, does not fall into the trap of making the work biochemical. It is a book written by a plant physiologist for plant physiologists (PRESTON *in* NATURE).

► **PLANTS AND PLANT SCIENCE IN LATIN AMERICA**, *edited by* **Frans Verdoorn**, Ph. D. — For a number of reasons the Editors of CHRONICA BOTANICA felt that an account concerning the vegetation and natural resources, as well as the present status and future of various branches of the plant sciences in Latin America, would be the most appropriate contribution they could make at present to the improvement of international relations and coöperation in the plant sciences, a field which presents in Latin America many problems of a great, often truly international, importance. — The aim of this collection of nearly a hundred accounts of the vegetation and plant resources (with information on agriculture, forestry, phytopathology, etc.) of the countries of C. and S. America is to give the agronomist, botanist, forester and phytopathologist, wherever he may be located, information which he may need when starting work on the wild or cultivated plants of Latin

America. It is hoped that it may be still more useful for those who plan to go to Latin America to collect or to conduct research. The collection endeavours to give some information concerning the present status of and the future possibilities and needs for research in the chief branches of the pure and applied plant sciences in Latin America. In addition to data in his own field, the specialist will find much useful and stimulating information on vegetational and agronomic problems in general, on the organization of research, lists of books that he may consult, addresses of institutions and societies in the territory in which he is interested and which he may profitably contact, etc. — Special features are the plates, often reproduced from classical publications, and the extensive introductory chapters by POPENOE (Problems of Tropical American Agriculture), JOHNSTON and SMITH (Vegetation Types), FOSBERG (Economic Botany), and PENNELL (History). There is also a special supplement by KRUG who reports in detail on plant breeding in C. and S. America. — A minor part of this volume has previously been published in CHRONICA BOTANICA and is now again presented after careful revision. Much more than half consists of original contributions, not published before, by outstanding international authorities. — *A New Series of Pl. Sci. Bks., Vol. 16 (1945)*; Sup. roy. oct., buckram, xl + 384 double column pp., 83 pl. and text illustr. ....................................... **$6.00**

*From the contents:* Introductory Essay ('The Plant Scientist in the World's Turmoils') by the Editor (with three extensive bibliographies, including a list of Latin American travel books of a plant science interest); *Popenoe:* Some problems of tropical American agriculture; *Smith & Johnston:* A phytogeographic sketch of Latin America; *Fosberg:* Principal economic plants of tropical America; *Pennell:* Historical sketch; *Patiño Navarrete:* La agricultura y los recursos vegetales de México; *Stakman & Harrar:* Plant pathology in Mexico; *Yuncker:* The vegetation of Honduras; *Kovar:* Idea general de la vegetación de El Salvador; *Lewy van Séveren:* Recursos naturales del reino vegetal de El Salvador; *Ashton:* On the plant resources and flora of Nicaragua; *Standley:* A brief survey of the vegetation of Costa Rica; *Carabia,* A brief review of the Cuban flora; *Roig y Mesa & Acuña:* Plant resources of Cuba; *Larter:* Plant resources of Jamaica; *Holdridge:* A brief sketch of the flora of Hispaniola; *Barker:* Plant resources of Hispaniola; *Holdridge:* A brief sketch of the Puerto Rican flora; *Horn:* Plant resources of Puerto Rico; *Stehlé:* Les conditions écologiques, la végétation et les ressources agricoles de l'Archipel des Petites Antilles; *Beard:* A brief review of the vegetation of Trinidad and Tobago; *Tiedjens:* Agriculture on the islands of Curaçao, Aruba and Bonaire; *Pittier & Williams:* A review of the flora of Venezuela; *Groves:* The plant resources of British Guiana; *Stahel:* The natural resources of Surinam; *Domingues:* A agricultura no Brasil; *Souza:* The Brazilian forests; *Hodge:* The plant resources of Peru; *Rojas & Carabia:* Breve reseña de la vegetación Paraguaya; *Carabia:* Productos naturales y agricultura en el Paraguay; *Parodi:* Las regiones fitogeográficas Argentinas y sus relaciones con la industria forestal; *Parodi:* La agricultura en la república Argentina; *Tortorelli:* Los bosques Argentinos y sus industrias derivadas; *Marchionatto:* Las enfermedades de las plantas cultivadas de la Argentina y sus problemas; *Rosengurtt Gurvich:* La vegetación del Uruguay; *Boerger:* Recursos vegetales del Uruguay; *Goodspeed:* Notes on the vegetation and plant resources of Chile; *Svenson:* A brief review of the Galapagos flora; *Skottsberg:* The Juan Fernandez and Desventuradas islands; *Darrah:* A geological sketch of Central America and the Antilles; *Stone:* Climatology and meteorology; *Pendleton:* Some important soils of Central America; *Bennett:* Soil conservation in Latin America; *Müller:* Plant pathology in Latin America; *Vichoever:* Food aspects in Latin America; *Bevan:* Forestry in Latin America and its future; *Hill:* Ethnobotany in Latin America; *Darrah:* Paleobotanical work in Latin America; *Rands:* Hevea rubber culture in Latin America, problems and procedures; *Brandes:* Progress in hemisphere rubber plantation development; *Uphof:* Certain minor rubber producing plants in the western hemisphere during times of emergency; *Pennock:* Notes on cinchona culture; *Guenther:* The production of essential oils in Latin America; *Markley:* Fat and oil resources of Latin America; *Robinson:* Aims, scope, and future of research on fiber plants in Latin America; *Motz:* On fruit production in South America; *Lanjouw:* On the location of botanical collections from Central and South America; *Bates:* The advantage of the tropical environment for studies on the species problem; *Ryerson:* Agricultural scholarships and inter-American relations; *Guest:* Some of the principal Latin American plant science periodicals; *Witt:* Coöperative agricultural research and extension stations in Latin America; *Crocker:* The Tropical Plant Research Foundation Inc.; *Krug:* Plant breeding, genetics and cytology in Latin America; *Ochoterena:* Outline of the geographic distribution of plants in Mexico; *Meyer:* Forestry in Mexico; *Lundell:* The vegetation and natural resources of British Honduras; *Popenoe:* Plant resources of Honduras; *Standley & Steyermark:* The vegetation of Guatemala; *Popenoe:* Plant resources of Guatemala; *Skutch:* The natural resources of Costa Rica; *Schery:* A few facts concerning the flora of Panama; *Shreve:* The vegetation of Jamaica; *Dugand:* On the vegetation and plant resources of Colombia; *Williams:* Natural resources of Venezuela; *Albert Smith:* The vegetation of the Guianas; *Lyman Smith:* The vegetation of Brazil; *Bitancourt:* Plant pathology in Brazil; *Svenson:* The vegetation of Ecuador; *Molestina O.:* Reseña agrícola del Ecuador; *Williams:* The phytogeography of Peru; *Cárdenas:* Recursos naturales del reino vegetal en Bolivia; *Skottsberg:* The Falkland islands; *Darrah:* A brief account of the geology of South America; *Hardy:* The soils of South America; *Emmons:* Medical mycology in Latin America; *Coolidge:* Notes on conservation in the Americas; *Paterson:* Grazing versus soiling in the wet tropics; *Verdoorn & Verdoorn:* Plant Science Institutions, stations, museums, gardens, societies and commissions in Central and South America.

Those who are interested both in Latin America and biology or agriculture, have long been looking for a compilation like "Plants and Plant Science in Latin America."—It will prove invaluable to many types of research workers as well as to educators and practical men (HENRY A. WALLACE).

► **MANUAL OF BRYOLOGY,** *edited by* **Frans Verdoorn,** Ph. D. — A coöperative manual dealing with all aspects of the general botany of mosses and hepatics, as well as with the principles of bryological taxonomy and phylogeny. — *Published in coöperation with Messrs. Nijhoff, the Hague (1932)*; Roy. oct., cloth, 485 pp., 129 plates and illustr....... **$12.00**

*Contents:* *van der Wijk:* Morphologie und Anatomie der Musci; *Buch:* Morphologie und Anatomie der Hepaticae; *Buch:* Experimentelle Morphologie; *Chalaud:* Germination des spores et phase protonémique; *Nicolas:* Association des Bryophytes avec d'autres organismes; *Motte:* Cytologie; *Hoefer:* Karyologie; *Garjeanne:* Physiology; *von Wettstein:* Genetik; *Herzog:* Geographie; *Gams:* Quaternary distribution; *Gams:* Bryo-Cenology (Moss-Societies); *Richards:* Ecology; *Dixon:* Classification of Mosses; *Verdoorn:* Classification of Hepatics; *Zimmermann:* Phylogenie.

Practically a general text-book of Bryology. Bryology like other branches of botany, suffers from lack of co-ordination among its workers: those occupied in general research sometimes have very little knowledge of the plants with which they deal. The taxonomists on the other hand, do not pay enough attention to general botanical research on the group. The present manual is an attempt to meet some of these difficulties. The book which is clearly printed and admirably produced forms a valuable addition to general botanical literature ((JOURNAL OF BOTANY).

Obwohl ein Eingehen auf die einzelnen Darstellungen schon wegen ihres ausserordentlichen Reichtums an Einzelheiten hier nicht erfolgen kann, darf doch festgestellt werden, dasz sie durchweg hervorragende Spezialisten zu Verfassern haben. Es war die Absicht des Herausgebers, den Einzelforschern den ausreichenden und zuverlässigen Einblick in die Nachbargebiete zu erleichtern und das ist ihm, mit diesem in jeder Hinsicht ausgestatteten Handbuch, in verdienstvoller Weise gelungen (BOTANISCHES ZENTRALBLATT).

► **MANUAL OF PTERIDOLOGY,** *edited* by **Frans Verdoorn,** Ph. D. — A coöperative manual dealing with all aspects of the general botany of ferns and fern allies, as well as with the principles of pteridological taxonomy and phylogeny. — *Published in*

*coöperation with Messrs. Nijhoff, the Hague (1938)*; Roy. oct., cloth, 640 pp., 121 plates and illustr...**$14.00**

*Contents: Schoute:* **Morphology and anatomy;** *Williams:* **Experimental morphology;** *Gregor:* **Associations with fungi and other lower plants;** *Burgeff:* **Mycorhiza;** *Docters van Leeuwen:* **Zoocecidia;** *Atkinson:* **Cytology;** *Döpp:* **Karyologie;** *Andersson-Kottö:* **Genetics;** *du Buy and Nuernbergk:* **Growth, tropisms and other movements;** *Wetzel:* **Chemie und Stoffwechsel;** *Gams:* **Oekologie der extratropischen Pteridophyten;** *Holttum:* **The ecology of tropical pteridophytes;** *Winkler:* **Geographie;** *Hirmer:* **Geographie und zeitliche Verbreitung der fossilen Pteridophyten;** *Kräusel:* **Psilophytinae;** *Walton and Alston:* **Lycopodiinae;** *Hirmer:* **Psilotinae und Articulatae;** *Christensen:* **Filicinae;** *Hirmer:* **Fossile filicinae und pteridophyta incertae sedis;** *Zimmermann:* **Phylogenie.**

The galaxy of twenty or more international authorities who have contributed under the able leadership of Fr. Verdoorn to the making of this unique volume on the pteridophytes makes this one of the outstanding botanical publications of the year. The articles are either in English or German, the illustrations are plentiful, and the printing leaves nothing to be desired (THE BIOLOGIST).

This book, although intended mainly for botanists, will be appreciated by horticulturists who specialize in the cultivation of Ferns (THE GARDENERS' CHRONICLE).

► **FOREST SOILS AND FOREST GROWTH** *by* **S. A. Wilde,** Sc. D. (Univ. of Wisconsin). — The subject matter of a course given for upper class and graduate students in forestry, soils, botany, game management, and landscape architecture, embracing a wide field of biology and earth sciences pertinent to soils and forests. Deals at length with the origin and genetical properties of forest soils, their physics, chemistry, and biology, relation to forest vegetation, and importance in silvicultural management. — *A New Series of Pl. Sci. Bks., Vol. 18*; Sup. roy. oct., buckram, ca. 250 pp., illustrated, *in press, ready shortly* ................................ *ca.* **$5.00**

*Contents:* Historical and introductory. Genesis of forest soils. Genetic soil groups of the world: Upland soils; Hydromorphic and embryonic soils. Forest cover: its biological structure and its relation to environment. Physical properties of forest soils. Chemical properties of forest soils. Organisms of forest soils. Forest humus. Soil-forest types. Forest soil survey. Soils and tree planting. Amelioration of forest soils. Thinning and selective logging in relation to soils. Productivity of forest soil and forest management. Establishment of forest nurseries and control of nursery watering. Use of commercial fertilizers and lime in forest nurseries. Use of composts, liquid fertilizers, and green manure crops in forest nurseries. Adjustment of nursery soil fertility. Control of parasitic organisms in soils of forest nurseries.

A fair balance is maintained between the theoretical foundations and the practical aspects of forest land utilization. All phases of silviculture, *viz.*, nursery practice, tree planting, and selective logging are treated from an ecological standpoint. The bibliography of several hundred references is up-to-date and international in scope.

► **HAYFEVER PLANTS, THEIR APPEARANCE, DISTRIBUTION, TIME OF FLOWERING AND THEIR ROLE IN HAYFEVER** *by* **Roger P. Wodehouse.** Ph. D. (Lederle Laboratories). — This book brings together very nearly all of the botany that it is desirable to know in order to gain a clear understanding of the rôle that plants and their pollen play as causes of the allergies, hayfever and asthma. It could as well be called the *Botany of Hayfever* or the *Botany of Allergy,* though it is not intended to reach much beyond the botanical aspects of hayfever and asthma. — The book was written largely in response to questions that have come to the author from members of the medical profession, from plant scientists and from sufferers of hayfever. — *A New Series of Pl. Sci. Bks., Vol. 15 (1945)*; Sup. roy. oct., buckram, 245 pp., 73 illustr......**$4.75**

*Contents:* The botany of hayfever (The Flower. What makes some plants cause hayfever? Hayfever toxicity. Atmospheric pollen. Identification. Preparation of pollen slides. Botanical literature. Cultivated plants. The trees. Monographs of restricted groups). The hayfever plants: Gymnosperms. The hayfever plants: Angiosperms. Regional surveys (The northeastern states. The middle atlantic states. The Virginias and Carolinas. The north-central states. The southern states. The southwest. Southern California. The north pacific states. The Rocky Mountain states. Plains and prairies). Glossary. Bibliography. Author Index. General Index.

The essentials of the various disciplines of botany are here brought together with the elimination of all materials not bearing directly on the study of hayfever and asthma. The book tells which plants cause hayfever, with special attention to the numerous and confusing vernacular and Latin names by which they have been designated in medical literature and elsewhere. It tells why certain plants cause hayfever while others, perhaps similar and closely related, do not. It tells how to recognize those which do by the structure of their flowers and inflorescences. It tells why hayfever plants grow in certain places and are excluded from others, and the effect of the impact of civilization on our environment in their distribution. It tells which are the primary and which the secondary causes of hayfever and their seasons of activity in the various floristic areas throughout North America. It tells how to catch grains of pollen out of the air and how to identify them and estimate their relative abundance.

Wodehouse's "Hayfever Plants" is indispensable to all physicians interested in allergy when managing their local hayfever problems, and it is the most complete authoritative text on the subject today. Medical allergists will welcome this authoritative book on the flora, responsible for clinical hayfever and asthma, indigenous to their respective areas, when treating their pollen-sensitive patients (FRED W. WITTICH, M.D., *in* ANNALS OF ALLERGY).

► **AN INTRODUCTION TO HISTORICAL PLANT GEOGRAPHY** *by* Dr. E. V. Wulff (Leningrad), *authorized translation by* **Elisabeth Brissenden.** *Foreword by* **Elmer D. Merrill.** — An original and authoritative account of the general and theoretical problems of historical plant geography, based on the author's famous Russian handbook, revised and brought up-to-date. This American edition has been prepared at the request of botanists from many parts of the world, as there exists not a similar modern book in English, German or French. — *A New Series of Pl. Sci. Bks., Vol. 10 (1943)*; Sup. roy. oct., 223 pp., 35 illustr. ..............................**$4.75**

The last few years have furnished to the phytogeographer such valuable new tools and so much fresh evidence, that a phase of expansion of the subject clearly lies ahead. Of this our botanical students are vaguely or not at all aware, and this first English text to reveal the new potentialities must therefore be valuable and welcome.—We can best convey the content of the book by the chapter headings: (1) historical plant geography: scope, relation to allied sciences, methods of investigation; (2) history of the science; (3) areas, their centres and boundaries; (4) the origin of areas; (5) types of areas; (6) parallelism in the geographical distribution of plants and animals and correlation between the distribution of parasites and that of their host plants; (7) artificial factors in the geographical distribution of plants; (8) natural factors in the geographical distribution of plants; (9) the migrations of species and floras and their causes; (10) historical causes for the present structure of areas and the composition of

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[This] series of books on different branches of plant science is the most noteworthy contribution to synthesised botanical presentation that has appeared in recent years . . . The publication of these fine works, each admirable and authoritative in its own sphere, is all the more praiseworthy in view of the difficulties of the present time. Dr. VERDOORN is to be congratulated on the success which has attended his enthusiastic editorship.

Nearly all the volumes published so far, including some translations, have been in English. Dr. VERDOORN's remarks are of interest in this connection. "I feel", he writes, "that the volumes of an international series of books, such as the 'New Series of Plant Science Books', should as a rule be in English. An occasional volume in French, German or Spanish may be interspersed to emphasize the international character of the undertaking, but if it is to have a truly international distribution, a book should be in the dominant world language". For this our "one-language scientists" should be humbly grateful. (COMPTON *in* JOURN. OF SO. AFRICAN BOTANY).

floras; (11) concept of floral elements (GODWIN *in* NATURE).

In spite of the war, and that means much more in Russia than in America, it has been possible to arrange for Miss BRISSENDEN to work in close association with Dr. WULFF in Leningrad and then to publish the completed manuscript in this country. Once more science surmounts international boundaries and the catastrophes of war. As Dr. MERRILL states this volume "is a mine of logically and authoritatively discussed information on the subject." The book will be of special value to plant geographers, because it analyzes a large amount of continental, especially Russian, literature not otherwise readily available (MATHER *in* AMERICAN SCIENTIST).

► MARINE MICROBIOLOGY *by* Claude E. ZoBell, Ph.D. (Scripps Inst. of Oceanography). — A monograph on hydrobacteriology with special reference to the distribution, characteristics, and activities of bacteria and allied microorganisms in oceans, seas, and lakes. — *A New Series of Pl. Sci. Bks., Vol. 17 (1946)*; Sup. roy. oct., buckram, 240 pp., 12 illustr., numerous tables.............................$5.00

*Contents:* Introduction. The marine environment. Collection and examination of samples at sea. Methods of enumerating marine bacteria. Factors influencing the distribution of bacteria in the sea. Microorganisms in bottom deposits. Activities of microorganisms in bottom deposits. Characteristics of marine bacteria. Aquatic yeasts and molds. Transformation of organic matter. The nitrogen cycle in the sea. Bacteria which transform sulfur compounds. The phosphorus cycle. Relation of marine bacteria to flora and fauna. Microorganisms in marine air. Sanitary aspects of marine microbiology. Economic importance of marine microorganisms. Microbiology of inland waters. Comprehensive index of both subjects treated and species of marine bacteria, yeasts, and molds. Bibliography of 672 references complete with titles.

The book is written from an ecological point of view with emphasis upon the effect of bacteria upon the marine environment and the effect of environmental conditions upon the distribution of microorganisms. The importance of bacteria and allied forms as biochemical, geological, and hydrobiological agents is also stressed. The specialized methods of studying bacteria in oceans and lakes are adequately treated.

Available, without charge, upon request: —

*'Plant Science Institutions and Societies of Latin America'* (*from* "Plants and Plant Science in Latin America").

CANNON & FIELD, *International Relations in Science* (*from* CHRONICA BOTANICA 9, 5/6).

*'A Portfolio of Plates mostly of historical interest and relating to Latin America'* (*from* "Plants and Plant Science in Latin America").

*'The Aims and Methods of Biological History and Biography'* —chiefly prepared for contributors to the *Index Botanicorum* (CHRON. 8, 4).—*Cf.* the note on p. xii (*right*).

A Portrait of RAFINESQUE (*from* CHRONICA BOTANICA 8, 2).

*Titles in preparation include:* Botanical Terminology (ASMOUS), Vegetation of California (AXELROD & MASON), History of Genetics (BABCOCK), Cyto-Geography (BALDWIN), Cotton Diseases (BARKER), Veget. of the Himalayas (BISWAS), Angewandte Pflanzensoziologie (BOYKO), Recent Adv. in Soybean Research (BURLISON), Origins of American Agriculture (G. F. CARTER), The Genus Radula (H. CASTLE), Los Naturalistas en la America Latina (CHARDON), The Fig (CONDIT), Water Relations (CRAFTS), Seed Physiology (CROCKER & BARTON), The Vegetation of Canada (DANSEREAU), Paleobotany of Coal (DARRAH), The Vegetation of Florida (DAVIS), Potato Diseases (DIJKSTRA), Botánica Systemática (DUGAND), Vegetation of Palestine (EVENARI & ZOHARY), The Vegetation of the Rocky Mountains (EWAN), Travels in Tropical America (FOSBERG), Allgemeine Arealkunde (GAMS), Cereal Chemistry (GEDDES), The Genus Nicotiana (GOODSPEED), Comparative Plant Biochemistry (HAAGEN-SMIT), Bacterial Plant Diseases (HILDEBRAND), Vegetable Gums and Resins (F. N. HOWES), Vegetation of China (HU), History of Soil Science (G. V. JACKS), Phytopathology in the American Tropics (J. R. JOHNSTON), Ethnobotany of the Indians of N. America (V. H. JONES), Mycorrhiza in Plants (KELLEY), The Tomato (LUCKWILL), History of Botany in India (MAJUMDAR), The Slime Molds (MARTIN), Pollen and Honey (MAURIZIO), Bamboo (McCLURE), Maize Diseases (MELHUS), Tree Mycorrhiza (MELIN), Coffee (A. J. T. MENDES), Selected General Writings (MERRILL), The Yeasts (NICKERSON), Biology of Pathogenic Fungi (NICKERSON, *ed.*), Soil Microbiology (NICOL), The Date Palm (NIXON), Problems and Methods in Bog and Swamp Research (OSVALD), Genera of Algae (PAPENFUSS), Vegetation of Argentina (PARODI), Jute (PATEL), Field Ecology (J. PHILLIPS), Phytologia Arctica (POLUNIN), Sugar Cane Diseases (RANDS), Vegetation of New England (RAUP), Tropical Plant Ecology (RAWITSCHER), Nuts and Nut Culture (C. A. REED), Ingenhousz as a Plant Physiologist (H. S. REED), Fusarium Diseases (REINKING), Vegetation der iberischen Halbinsel (ROTHMALER), Vegetation of the Hawaiian Islands (ST. JOHN), Ethnobotany of the Indians of Tropical America (SCHULTES), Hepaticae of N. E. America (SCHUSTER), Plant Life in the Caribbean (SEIFRIZ), Introduction to Bryogeography (SHARP), The Prairies and Plains of N. America (SHINNERS), Veget. of the American Desert (F. SHREVE), The Agaricales (Mushrooms) (SINGER), Manual of Phycology (G. M. SMITH, *ed.*), Manual of Aerobiology (STAKMAN, *ed.*), Physiologic Specialization in Phytopathogenic Fungi (STAKMAN & CHRISTENSEN), Genera of Mosses of N. America (STEERE), Histoire de la Botanique et de l'Agronomie aux Antilles Françaises (STEHLÉ), Nematode Diseases (STEINER), Plant Disease Control (N. E. STEVENS), Horticultural Plant Physiology (STOUGHTON), Growth Hormones in Horticultural Practice (STOUTEMYER), Fungous Diseases (TERVET), Wood Anatomy (TIPPO), Economic Phycology (TSENG), Hookeriana (TURRILL, *ed.*), Dictionary of Economic Botany (UPHOF), Tobacco Diseases (VALLEAU), Diseases of Bulbous Plants (VAN SLOGTEREN), The Actinomycetales (WAKSMAN), The Genus Fontinalis (WELCH), Vernalization and Photoperiodism, A Symposium (WHYTE, MURNEEK & others), Herbage and Forage Crops (WHYTE & HALL), Plant Microfossils (L. R. WILSON), Thesaurus Lit. Hepaticologicae (F. & J. VERDOORN).

*Most of the above titles will be published in* "A NEW SERIES OF PLANT SCIENCE BOOKS" *(see p. ii), others in* ANNALES CRYPTOGAMICI ET PHYTOPATHOLOGICI *(see p. ii), and a few in* CHRONICA BOTANICA *(see p. xii) and simultaneously as separate books or booklets.*

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► *If you have any photographs or prints of agronomists, botanists, horticulturists, etc., pictures of plant science meetings, congresses, buildings, gardens, etc., biographical or historical reprints, and other documents, letters, autographs and plant science memorabilia of any kind, which are no longer of use to you, please send them to "Chronica Botanica Archives, the Chronica Botanica Co., Waltham 54, Mass." Material of this kind is carefully filed and made available to those of our numerous phytohistorical collaborators who can use it.*

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► *The Editors of* CHRONICA BOTANICA *are grateful for all circulars, programmes, reports, notes, press communications, membership lists, directories, and other publications coming within the scope of their journal. To fulfill their purpose they rely on the active collaboration of institutions, societies and workers in all branches of the plant sciences.—Directors of herbaria, musea, and botanic gardens are earnestly invited to send us from time to time lists of their more important acquisitions.*

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